# SERVICE MANUAL

BSM- 5105A
BSM- 5105K
BSM- 5106A
BSM- 5135A
BSM- 5135K
BSM- 5136A
WS- 510P

# *Life Scope A*
# BEDSIDE MONITOR

## BSM-5100

0634-001913C

NIHON KOHDEN

Model: BSM-5100A/K

Manual code no.: 0634-001913C

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## EMC RELATED CAUTION

**This equipment and/or system complies with the International Standard IEC60601-1-2 for electromagnetic compatibility for medical electrical equipment and/or system. However, an electromagnetic environment that exceeds the limits or levels stipulated in the IEC60601-1-2, can cause harmful interference to the equipment and/or system or cause the equipment and/or system to fail to perform its intended function or degrade its intended performance. Therefore, during the operation of the equipment and/or system, if there is any undesired deviation from its intended operational performance, you must avoid, identify and resolve the adverse electromagnetic effect before continuing to use the equipment and/or system.**

**The following describes some common interference sources and remedial actions:**

1. **Strong electromagnetic interference from a nearby emitter source such as an authorized radio station or cellular phone:**
   **Install the equipment and/or system at another location if it is interfered with by an emitter source such as an authorized radio station. Keep the emitter source such as cellular phone away from the equipment and/or system.**

2. **Radio-frequency interference from other equipment through the AC power supply of the equipment and/or system:**
   **Identify the cause of this interference and if possible remove this interference source. If this is not possible, use a different power supply.**

3. **Effect of direct or indirect electrostatic discharge:**
   **Make sure all users and patients in contact with the equipment and/or system are free from direct or indirect electrostatic energy before using it. A humid room can help lessen this problem.**

4. **Electromagnetic interference with any radio wave receiver such as radio or television:**
   **If the equipment and/or system interferes with any radio wave receiver, locate the equipment and/or system as far as possible from the radio wave receiver.**

**If the above suggested remedial actions do not solve the problem, consult your Nihon Kohden Corporation subsidiary or distributor for additional suggestions.**

**The CE mark is a protected conformity mark of the European Community. The products herewith comply with the requirements of the Medical Device Directive 93/42/EEC.**

**The CE mark only applies to the BSM-5100K Bedside Monitors.**

**This equipment complies with International Standard IEC60601-1-2 (1993) which requires CISPR11, Group 1, Class B. Class B EQUIPMENT is equipment suitable for use in domestic establishments and in establishments directly connected to a low voltage power supply network which supplies buildings used for domestic purposes.**

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## Conventions Used in this Manual and Instrument

### Warnings, Cautions and Notes

Warnings, cautions and notes are used in this manual to alert or signal the reader to specific information.

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**WARNING**

**A warning alerts the user to possible injury or death associated with the use or misuse of the instrument.**

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**CAUTION**

**A caution alerts the user to possible injury or problems with the instrument associated with its use or misuse such as instrument malfunction, instrument failure, damage to the instrument, or damage to other property.**

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**NOTE**

**A note provides specific information, in the form of recommendations, prerequirements, alternative methods or supplemental information.**

## Explanations of the Symbols in this Manual and Instrument

The following symbols found in this manual/instrument bear the respective descriptions as given.

### On panels

| Symbol | Description | Symbol | Description |
|---|---|---|---|
| | Standby | | Defibrillation-proof type CF applied part |
| | "On" only for a part of instrument | | Defibrillation-proof type BF applied part |
| | "Off" only for a part of instrument | | Type CF applied part |
| | Battery | | Type BF applied part |
| | Battery charging | | Data input/output |
| | Record start/stop | | Input/output terminal |
| | Out of paper | | Alternating current |
| | Alarm suspend | | Equipotential terminal |
| | NIBP | | Remote terminal |
| | NIBP interval | | Year of manufacture |
| | NIBP start | | Serial number |
| | NIBP stop | | Protective earth |
| | Menu | | High voltage |
| | Home (monitoring screen) | | The CE mark is a protected conformity mark of the European Community. The products herewith comply with the requirements of the Medical Device Directive 93/42/EEC. |
| | Attention, consult operator's manual | | |
| | Output | | |
| | Fuse | | |

### On screen

| Symbol | Description | Symbol | Description |
|---|---|---|---|
| | Alarm suspend with remaining minutes | | QRS/pulse sync mark |
| | Alarm off | | Respiration sync mark |
| | Alarm recording off | | Value out of range |
| | Recording | | Current setting |
| | Paper magazine open | | Adjust setting |
| | Out of paper | | Touch screen calibration mark |
| | Function key | | Change scale |
| | | | Network communicating |

### Others

| Symbol | Description |
|---|---|
| | Recycle (On battery pack) |
| | Positive terminal |
|  | Negative terminal |
| | Functional earth |

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# Introduction

This service manual provides useful information to qualified personnel to understand, troubleshoot, service, maintain and repair the BSM-5100A/K Bedside Monitor (referred to as "the instrument" in this service manual).

The information in the operator's manual is primarily for the user. However, it is important for service personnel to thoroughly read the operator's manual and service manual before starting to troubleshoot, service, maintain or repair this instrument. This is because service personnel need to understand the operation of the instrument in order to effectively use the information in the service manual.

# General Information on Servicing

Note the following information when servicing the instrument.

**CAUTION**

**Safety**

- **There is the possibility that the outside surface of the instrument, such as the operation keys, could be contaminated by contagious germs, so disinfect and clean the instrument before servicing it. When servicing the instrument, wear rubber gloves to protect yourself from infection.**
- **There is the possibility that when the lithium battery is broken, a solvent or toxic substance inside the lithium battery could leak out. If the solvent or toxic substance touches your skin or gets into your eye or mouth, immediately wash it with a lot of water and see a physician.**

**Liquid ingress**

**The instrument is not drip-proof, so do not install the instrument where water or liquid can get into or fall on the instrument. If liquid accidentally gets into the instrument or the instrument accidentally drops into liquid, disassemble the instrument, clean it with clean water and dry it completely. After reassembling, use the patient safety checks and function/performance checks to verify that there is nothing wrong. If there is something wrong with the instrument, contact your Nihon Kohden representative for repair.**

**Environmental Safeguards**

**Depending on the local laws in your community, it may be illegal to dispose of the lithium battery and CRT unit in the regular waste collection. Check with your local officials for proper disposal procedures.**

**Disinfection and cleaning**

**To disinfect the outside surface of the instrument, wipe it with a non-abrasive cloth moistened with any of the disinfectants listed below. Do not use any other disinfectants or ultraviolet rays to disinfect the instrument.**

- **Chlorohexidine gluconate solution: 0.5%**
- **Benzethonium chloride solution: 0.2%**
- **Glutaraldehyde solution: 2.0%**
- **Benzalkonium chloride: 0.2%**
- **Hydrochloric alkyl diaminoethylglycine: 0.5%**

**Transport**

- **Use the specified shipment container and packing material to transport the instrument. If necessary, double pack the instrument. Also, put the instrument into the shipment container after packing so that the buffer material does not get inside the instrument.**
- **When transporting a board or unit of the instrument, be sure to use a conductive bag. Never use an aluminum bag when transporting the power board, power unit or board on which a lithium battery is mounted. Also, never wrap the board or unit of the instrument with styrene foam or a plastic bag which generates static electricity.**

**Handling the instrument**

- **Because the outside surface of the instrument is made of resin, it can be easily damaged. When handling the instrument, remove clutter from around the instrument and be careful not to damage the instrument or get it dirty.**
- **Because most of the boards in the instrument are multilayer boards with surface mounted electrical devices (SMD), a special tool is required when removing and soldering the electrical devices. To avoid damaging other electrical components, do not remove and solder SMD components yourself.**

**Measuring and Test Equipment**

**Maintain the accuracy of the measuring and test equipment by checking and calibrating it according to the check and calibration procedures.**

# Service Policy, Service Parts and Patient Safety Checks

## Service Policy

Our technical service policy for this instrument is to replace the faulty unit, board or part or damaged mechanical part with a new one. Do not perform electrical device or component level repair of the multilayer board or unit. We do not support component level repair outside the factory for the following reasons:

- Most of the boards are multilayer boards with surface mounted electrical devices, so the mounting density of the board is too high.
- A special tool and special repair skill is required to repair the multilayer boards with surface mounted electrical devices.

Disassemble the instrument or replace a board or unit in an environment where the instrument is protected against static electricity.

As background knowledge for repair, pay special attention to the following:

- You can reduce the repair time by considering the problem before starting repair.
- You can clarify the source of most of the troubles using the information from the diagnostic check function of the instrument. Refer to "Diagnostic Check " of this manual.

## Service Parts

Refer to "Replaceable Parts List" of this manual for the service parts for technical service that we provide.

**NOTE**

**When ordering parts or accessories from your Nihon Kohden representative, please quote the NK code number and part name which is listed in this service manual, and the name or model of the unit in which the required part is located. This will help us to promptly attend to your needs. Always use parts and accessories recommended or supplied by Nihon Kohden Corporation to assure maximum performance from your instrument.**

## Patient Safety Checks

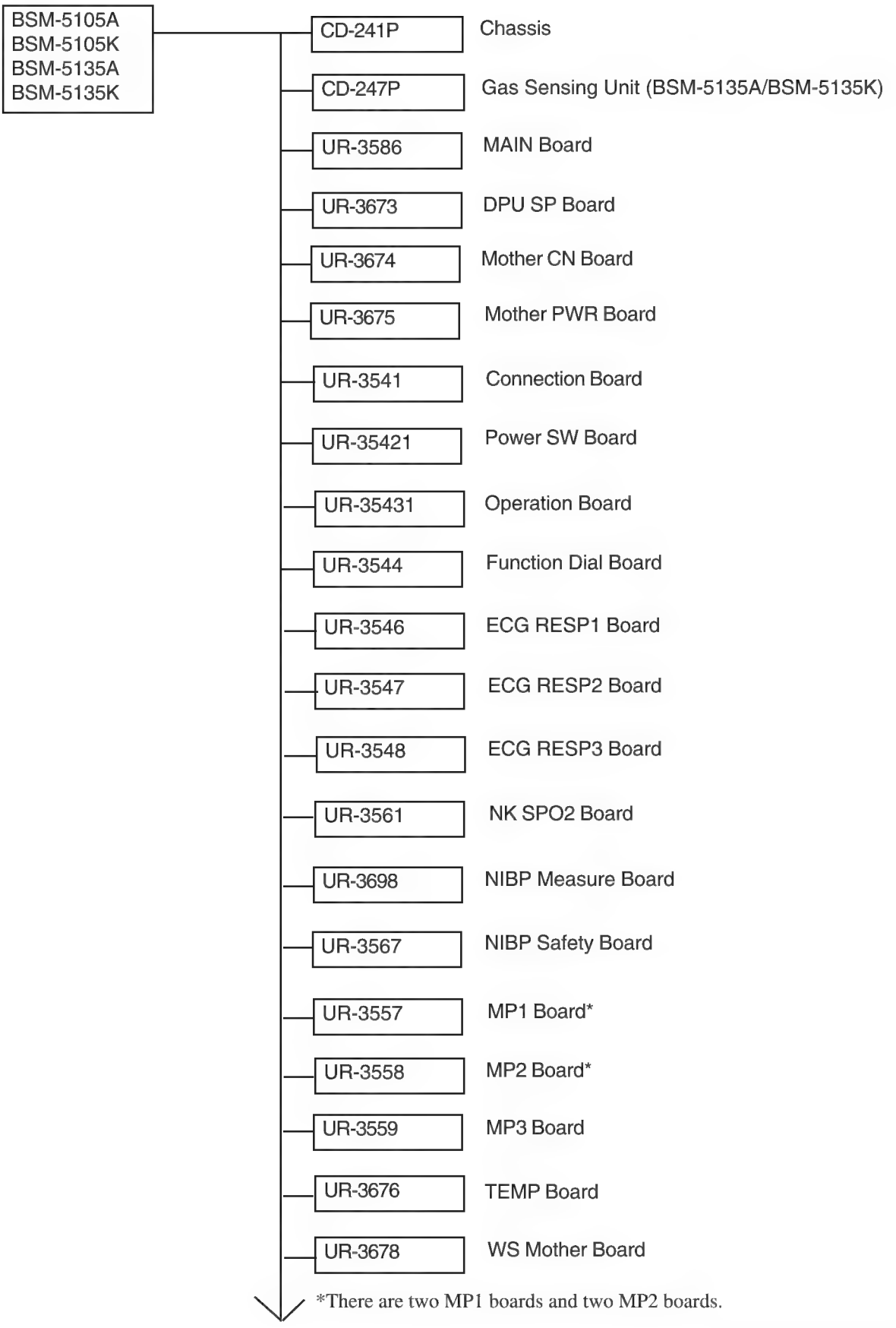
Periodic maintenance procedures and diagnostic check procedures are provided in this manual to ensure that the instrument is operating in accordance with its design and production specifications. To verify that the instrument is working in a safe manner with regard to patient safety, patient safety checks should be performed on the instrument before it is first installed, periodically after installation, and after any repair is made on the instrument.

For patient safety checks, perform the following checks as described in the International Electrotechnical Commission's standard, IEC60601-1 (1988):

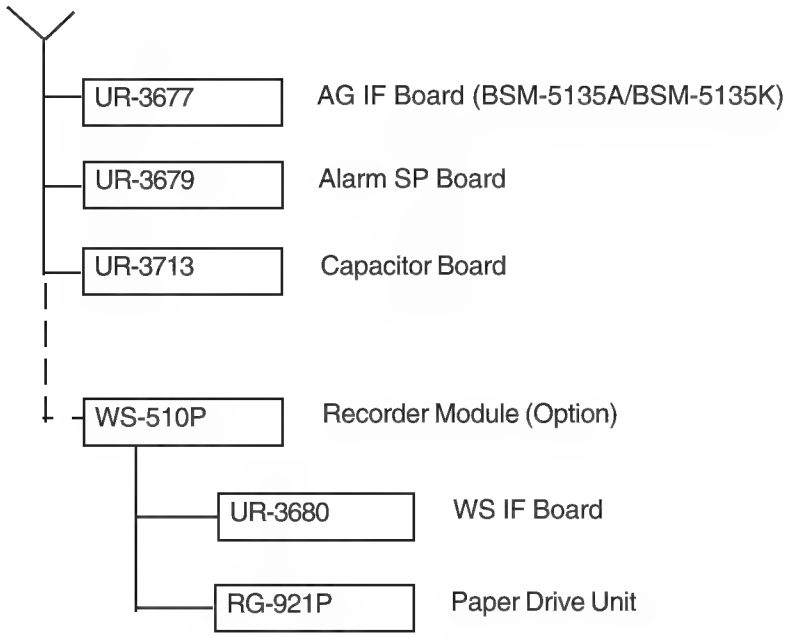
- Protective earth resistance check
- Earth leakage current check
- Enclosure leakage current check
- Patient leakage current check
- Withstanding voltage check

# Composition

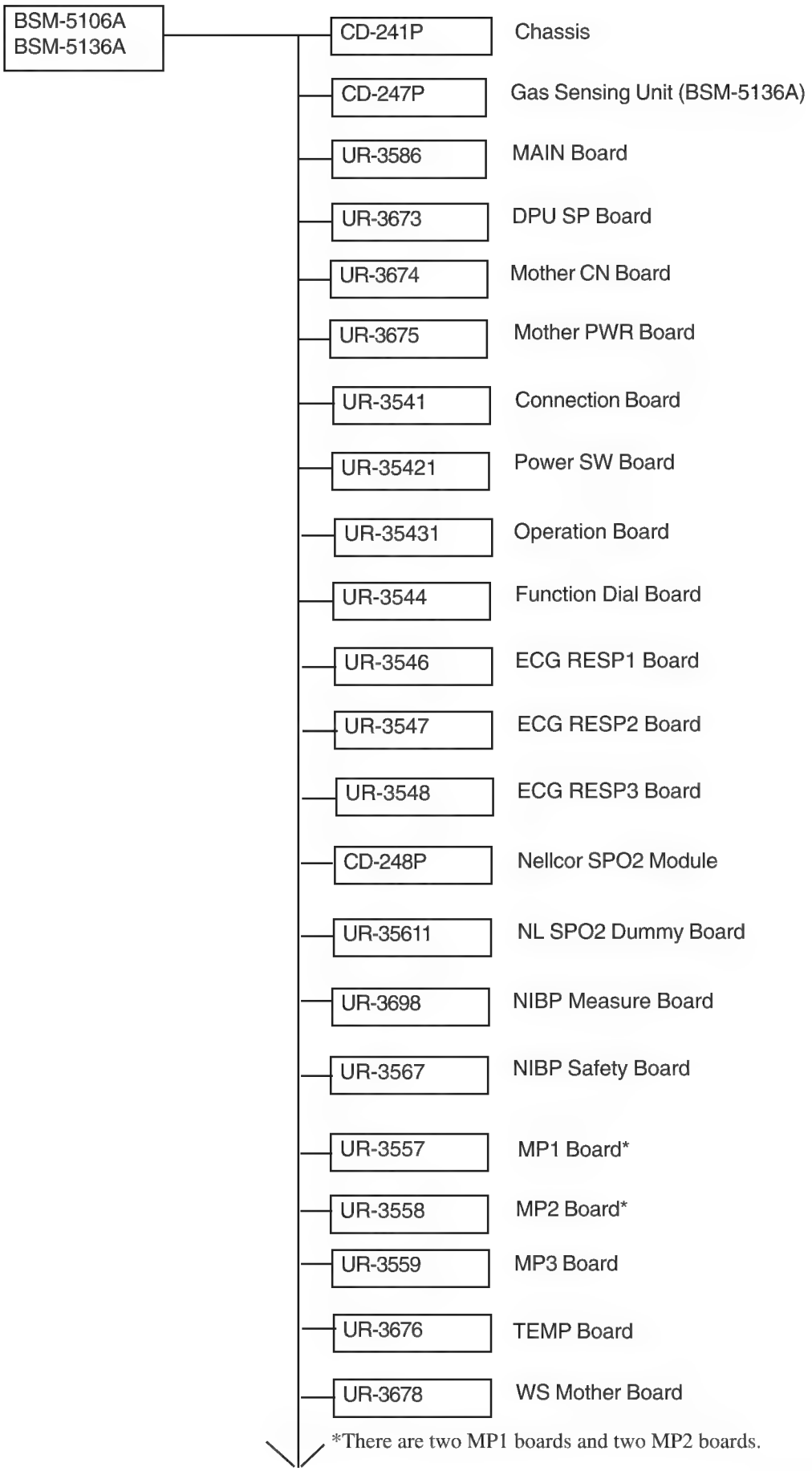
## BSM-5105/5135



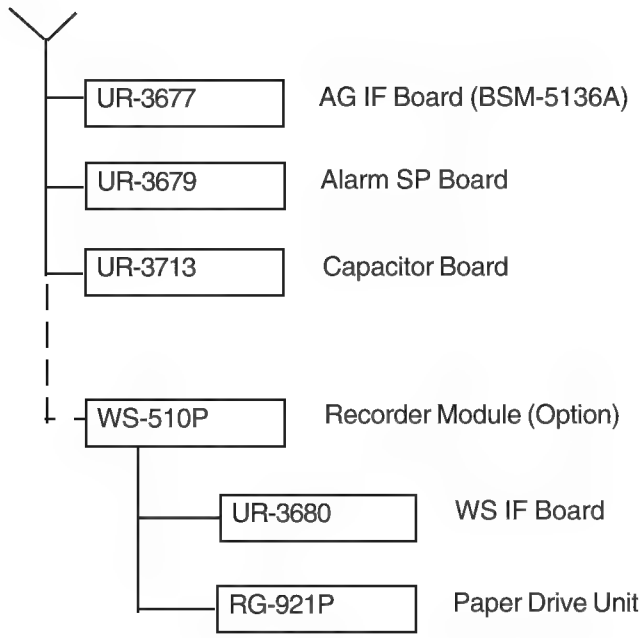

*There are two MP1 boards and two MP2 boards.


UR-3677
AG IF Board (BSM-5135A/BSM-5135K)
UR-3679
Alarm SP Board
UR-3713
Capacitor Board
WS-510P
Recorder Module (Option)
UR-3680
WS IF Board
RG-921P
Paper Drive Unit

## BSM-5106/5136




*There are two MP1 boards and two MP2 boards.


UR-3677
AG IF Board (BSM-5136A)
UR-3679
Alarm SP Board
UR-3713
Capacitor Board
WS-510P
Recorder Module (Option)
UR-3680
WS IF Board
RG-921P
Paper Drive Unit

# Specifications

### Display

| | |
|---|---|
| Display size: | 12.1 inch, TFT type LCD |
| Waveform display mode: | Non-fade moving or non-fade fixed |
| Viewing area: | 246 mm × 184.5 mm |
| Resolution: | 800 × 600 dots |
| Maximum number of waveform trace: | 13 traces (12 lead display)<br>10 traces (monitoring screen) |
| Sweep speed: | 25 mm/s, 50 mm/s (Respiration/$CO_2$ speed selectable from 1, 5 or 25 mm/s, gas parameters (anesthetic gas) fixed at 6 mm/s) |
| Sweep time: | 6.9 s (at 25 mm/s sweep speed) |
| Waveform display color: | 12 |
| Numeric display color: | 12 |
| Waveform freeze: | Provided |
| Display waveforms: | ECG, respiration, IBP, $SpO_2$ pulse wave, $CO_2$ and CO thermodilution curve<br>When gas is monitored, $CO_2$, $N_2O$,$O_2$ and two agents with the highest concentration |
| Numerical data display: | Heart rate, VPC rate, ST level, respiration rate, IBP (systolic, diastolic, mean), NIBP (systolic, diastolic, mean), $SpO_2$, pulse rate, temperature, CO, $FiO_2$, $ETCO_2$<br>When gas is monitored, $EtCO_2$, $FiCO_2$, $EtN_2O$, $FiN_2O$, $EtO_2$, $FiO_2$ and Et and Fi of the two agents with the highest concentration |
| Synchronization mark: | Heart rate sync mark, pulse rate sync mark, respiratory sync mark |

### Sound

| | |
|---|---|
| Sound type: | Alarm, synchronization, click |
| Alarm sound: | 4 types (pips, bing bongs, bong, bing 3 times) |
| Synchronization sound: | Pitch variable for IBP and $SpO_2$ |

### Alarm

| | |
|---|---|
| Alarm items: | Upper/lower limits alarm, apnea alarm, arrhythmia alarm, connector disconnection alarm, noise alarm, electrode off alarm, waveform detecting alarm, probe off alarm, cuff/hose check alarm, sensor check alarm, low battery alarm, operating environment alarm |
| Alarm levels: | Crisis (red blinking), Warning (yellow blinking), Advisory (yellow lighting) |
| Alarm indication: | Alarm indicator, highlighted message, alarm sound |
| Alarm suspend: | Provided (for 1 or 2 min) |

### ECG

| | |
|---|---|
| Electrode offset potential tolerance: | ±500 mV |
| Input dynamic range: | ± 5 mV |
| Internal noise: | ≤20 μVp-p (Refer to input) |
| Common mode rejection ratio: | ≥90 dB |
| Input impedance | ≥5 MΩ (at 10 Hz) |
| Input bias current: | ≤100 nA |
| Heart rate count | |
| Calculation method: | Moving average/Instantaneous beat to beat (selectable) |
| Counting range: | 0, 12 to 300 beats/min (±2 beats/min) |

| | |
|---|---|
| Arrhythmia analysis | |
| Analysis method: | Template matching method |
| Number of channels: | 1 channel |
| VPC counting rate: | 0 to 99 VPCs/min |
| Arrhythmia message: | ASYSTOLE, VT, VF, VPC RUN, COUPLET, EARLY VPC, BIGEMINY, FREQ VPC, TACHYCARDIA, BRADYCARDIA, NOISE, CHECK ELECTRODES, LEARNING |
| Arrhythmia recall: | |
| Number of recall files: | 100 |
| Storage time per file: | 8 s |
| ST level measurement: | |
| Number of measurement channels: | 3-electrodes: 1 ch<br>6-electrodes: 8 ch<br>10-electrodes: 12 ch |
| Measuring range: | ±2.5 mV |
| Number of recall files: | 500 files for all monitoring leads |
| Pacemaker pulse rejection capability: | 0.1 to 2 ms, ±2 to 700 mV<br>ANSI/AAMI EC 13-1992 compatible<br>Pacing pulse detection ON/OFF |
| Defibrillation-proof: | ECG input protected against 400 J<br>IEC 60601-2-27 17.101 compatible |
| ESU interference filter: | Provided |
| Time constant: | 0.5 or 3.2 s |
| AC hum filter: | OFF: 150 ±10 Hz (> –3 dB)<br>ON: 23 ±3 Hz (> –3 dB)<br>≤ –16 dB (50 Hz or 60 Hz) |
| Lead: | |
| 3-electrode cable: | I, II, III |
| 6-electrode cable: | I, II, III, aVR, aVL, aVF, 2 from V1 to V6 |
| 10-electrode cable: | I, II, III, aVR, aVL, aVF, V1 to V6 |
| Waveform display: | |
| Display sensitivity: | 10 mm/mV ±5% (at ×1 sensitivity) |
| Number of channels: | 3 (maximum, with 6 or 10 electrodes) |
| Sensitivity control: | ×1/4, ×1/2, ×1, ×2, ×4, or AUTO |
| Auto positioning: | Available |
| Pacing spike display: | Available |
| Heart rate display update cycle: | Every 3 s or when alarm is generated |
| Alarm items: | |
| Upper limit range: | 20 to 300 beats/min in 5 beats/min steps, OFF |
| Lower limit range: | OFF, 15 to 295 beats/min in 5 beats/min steps |
| Alarm items: | TACHYCARDIA, BRADYCARDIA, ASYSTOLE |
| 12 lead ECG interpretation: | Available when monitoring 12 leads |

**Respiration (Transthoracic impedance pneumography)**

| | |
|---|---|
| Measuring impedance available range: | 0 to 2 kΩ |
| Internal noise: | ≤0.2 Ω (Refer to input) |
| Excitor current: | 30 ±10 μArms at 31.25 kHz |
| Frequency response: | 0.1 to 3.2 Hz ±1 Hz (–3 dB) |
| Respiration counter counting range: | 0 to 150 breaths/min |
| Respiration rate counting accuracy: | ±2 breaths/min |

| | |
|---|---|
| Defibrillation proof: | Respiration input protected against 400 J discharge |
| Waveform display: | |
| Display sensitivity: | 10 mm/Ω ±25% (at ×1 sensitivity) |
| Sensitivity control: | ×1/4, ×1/2, ×1, ×2, ×4 |
| Respiration rate display update cycle: | Every 3 s or when alarm is generated |
| Alarm: | |
| Upper limit range: | 2 to 150 breaths/min in 2 breaths/min steps, OFF |
| Lower limit range: | OFF, 0 to 148 breaths/min in 2 steps |
| Apnea time: | OFF, 5 to 40 s in 5 s steps |

**$SpO_2$ on BSM-5105/5135 Monitors**

| | |
|---|---|
| Measuring range: | 1 to 100% |
| $SpO_2$ accuracy: | ±1 digits (80% ≤ $SpO_2$ ≤ 100%) |
| | ±2 digits (50% ≤ $SpO_2$ < 80%) |
| $SpO_2$ display: | |
| Pulse rate display update cycle: | Every 3 s or when alarm is generated |
| Sync tone modulation: | Change in 20 steps at 81 to 100% $SpO_2$ |
| Waveform sensitivity: | ×1/8, ×1/4, ×1/2, ×1, ×2, ×4, ×8 or AUTO |
| Alarm: | |
| Upper limit range: | 51 to 100% $SpO_2$ in 1% $SpO_2$ steps, OFF |
| Lower limit range: | OFF, 50 to 99% $SpO_2$ in 1% $SpO_2$ steps |

**$SpO_2$ on BSM-5106/5136 Monitors**

| | | |
|---|---|---|
| Measuring range: | 1 to 100% | |
| $SpO_2$ accuracy: | DS-100A: | ±3% $SpO_2$ |
| | OXIBAND A/N: | ±3% $SpO_2$ |
| | OXIBAND P/I: | ±3% $SpO_2$ |
| | RS-10: | ±3.5% $SpO_2$ |
| | D-YS: | ±3% $SpO_2$ |
| | D-YSE: | ±3.5% $SpO_2$ |
| | D-YSPD: | ±3.5% $SpO_2$ |
| | D-25/D-25L: | ±2% $SpO_2$ |
| | N-25: | ±2% $SpO_2$ |
| | I-20: | ±2% $SpO_2$ |
| | D-20: | ±2% $SpO_2$ |
| | R-15: | ±3.5% $SpO_2$ |
| | OXICLIQ I: | ±2.5% $SpO_2$ |
| | OXICLIQ P: | ±2.5% $SpO_2$ |
| | OXICLIQ A: | ±2.5% $SpO_2$ |
| | OXICLIQ N: | ±2.5% $SpO_2$ |
| | OXI1-2-3 A/N: | ±2.5% $SpO_2$ |
| | OXI1-2-3 P/I: | ±2.5% $SpO_2$ |
| $SpO_2$ display: | | |
| Pulse rate display update cycle: | Every 3 s or when alarm is generated | |
| Sync tone modulation: | Change in 20 steps at 81 to 100% $SpO_2$ | |
| Waveform sensitivity: | ×1/8, ×1/4, ×1/2, ×1, ×2, ×4, ×8 or AUTO | |
| Alarm: | | |
| Upper limit range: | 51 to 100% $SpO_2$ in 1% $SpO_2$ steps, OFF | |
| Lower limit range: | OFF, 50 to 99% $SpO_2$ in 1% $SpO_2$ steps | |

### Non Invasive Blood Pressure, NIBP

| | |
|---|---|
| Measuring method: | Oscillometric |
| Cuff pressure display range: | 0 to 300 mmHg |
| Accuracy: | ±3 mmHg (0 mmHg ≤ NIBP ≤ 200 mmHg) |
| | ±4 mmHg (200 mmHg ≤ NIBP ≤ 300 mmHg) |
| Safety: | |
| Maximum pressurization value cuff inflation limiter: | Adult 300 to 330 mmHg |
| | Neonates 150 to 165 mmHg |
| Cuff inflation time limiter: | Adult 161 to 165 s |
| | Neonates 81 to 84 s |
| Measurement mode: | Manual |
| | STAT |
| | Periodic: 2, 2.5, 5, 10, 15, 30 min, 1, 2, 4, 8 hr interval |
| NIBP data display update cycle: | Updated every measurement |
| Measurement completion sound: | Generated at every measurement completion when set on the SYSTEM SETUP screen |
| Alarm: | |
| Upper limit range: | 15 to 260 mmHg in 5 mmHg steps, OFF |
| Lower limit range: | OFF, 10 to 255 mmHg in 5 mmHg steps |

### Invasive Blood Pressure, IBP

| | |
|---|---|
| Measuring range: | –50 to 300 mmHg |
| Measuring accuracy: | ±1 mmHg ±1 digit (–50 mmHg ≤ IBP < 100 mmHg) |
| | ±1% ±1 digit (100 mmHg ≤ IBP ≤ 300 mmHg) |
| Auto zero balancing range: | ±200 mmHg |
| Auto zero balancing accuracy: | ±1 mmHg |
| Transducer sensitivity: | 50 µV/V/10 mmHg |
| Pulse rate counting range: | 0, 12 to 300 beats/min |
| Pulse rate counting accuracy: | ±2 beats/min |
| Noise: | Within ±1 mmHg |
| Temperature zero drift: | ±0.1 mmHg/1°C |
| Frequency response: | DC to 20 Hz ±3Hz |
| | DC to 12 Hz ±3Hz |
| Display update cycle: | Every 3 s or when alarm occurs |
| BP sync sound: | Provided, systolic value 20 to 120 mmHg, changes in 20 steps every 5 mmHg |
| Alarm: | |
| Upper limit range: | 2 to 300 mmHg in 2 mmHg steps, OFF |
| Lower limit range: | OFF, 0 to 298 mmHg steps in 2 mmHg steps |

### Temperature

| | |
|---|---|
| Measuring range: | 0 to 45°C |
| Number of channels: | 4 maximum (2 TEMP sockets, 1 multi-parameter socket) |
| Measuring accuracy: | ±0.1°C (25°C ≤ Temp ≤ 45°C) |
| | ±0.2°C ( 0°C ≤ Temp < 25°C) |
| Temperature drift: | within ±0.005°C /°C |
| Temperature range: | |
| Display range: | 0°C to 45°C (32 to 115°F) |
| Display update cycle: | Every 3 s |

Alarm:

| | |
|---|---|
| Upper limit range: | 0.1 to 45°C (33 to 113°F) in 0.1°C (1°F) steps, OFF |
| Lower limit range: | OFF, 0 to 44.9°C (32 to 112°F) in 0.1°C (1°F) steps |

### Cardiac Output, CO

| | |
|---|---|
| Measuring method: | Thermodilution method |
| Measuring range: | |
| Injectate temperature (Ti): | 0°C to 27°C |
| Blood temperature (Tb): | 15°C to 45°C |
| Thermodilution curve (delta Tb): | 0°C to 2.5°C |
| Cardiac output (CO): | 0.1 to 20 L/min |
| Measuring accuracy: | |
| Ti: | ±0.2°C |
| Tb 25 to 45°C: | ±0.1°C |
| Tb 15 to 25°C: | ±0.2°C |
| CO: | ±5% |
| Temperature drift: | |
| Ti: | ±0.005°C /°C |
| Tb: | ±0.005°C /°C |
| Frequency response (delta Tb): | DC to 3 Hz (–3 dB) |
| Injectate volume range: | 3, 5, 10 mL (7F) |
| | 1, 2, 3, 4, 5 mL (5F) |

### Respiration (Thermistor method)

| | |
|---|---|
| Respiration rate counting range: | 0 to 150 breaths/min |
| | Apnea, 5 to 40 s |
| Accuracy: | ±2 breaths/min |
| Noise: | Within 2.5 Ω (Refer to input) |
| Frequency response: | 0.1 to 3 Hz (–3 dB) |
| Waveform display | |
| Display sensitivity: | 10 mm/100 Ω ±10% (at ×1 sensitivity) |
| Sensitivity control: | ×1/4, ×1/2, ×1, ×2, ×4 |
| Respiration rate display update cycle: | Every 3 s or when alarm occurs |
| Alarm: | |
| Upper limit range: | 2 to 150 breaths/min in 2 breaths/min steps, OFF |
| Lower limit range: | OFF, 0 to 148 breaths/min in 2 breaths/min |
| Apnea time: | OFF, 5 to 40 s in 5 s steps |

### Inspired Oxygen Fractional Concentration, $FiO_2$

| | |
|---|---|
| Measuring range: | 10 to 100% $O_2$ |
| Accuracy: | ±3% full scale (When calibrated at 21% $O_2$) |
| | ±2% full scale (When calibrated at 100% $O_2$) |
| Temperature drift: | ±0.12% $O_2$/°C |
| $FiO_2$ display update cycle: | Every 3 s or when alarm is generated |
| Alarm: | |
| Upper limit range: | 19 to 100% in 1% steps, OFF |
| Upper limit range: | OFF, 18 to 99% in 1% steps |

### Expired Carbon Dioxide Tension, $CO_2$

For the TG-900P/TG-950P $CO_2$ sensor kit specifications, refer to the kit manual.

| | |
|---|---|
| Measuring method: | Mainstream (TG-900P: semi-quantitative, TG-950P: quantitative) |
| $CO_2$ measuring range: | 0 to 99 mmHg |
| $CO_2$ measuring accuracy: | |
| TG-900P: | ±4 mmHg ($0 \leq CO_2 \leq 40$ mmHg) |
| | ±10% reading ($40 < CO_2 \leq 76$ mmHg) |
| | (When 1 atmospheric pressure, air inspiration, no condensation) |
| TG-950P: | ±2 mmHg ($0 \leq CO_2 \leq 40$ mmHg) |
| | ±5% reading ($40 < CO_2 \leq 70$ mmHg) |
| | ±7% reading ($70 < CO_2 \leq 100$ mmHg) |
| | (When no condensation, BTPS (body temperature 37°C, ambient pressure, saturated with vapor)) |
| Warm-up time: | 5 s (minimum) |
| Response time | |
| TG-900P: | 200 ms (typical) for steps from 10 to 90% |
| TG-950P: | 60 ms (typical) for steps from 10 to 90%, delay time 100 ms ±10 ms |
| Respiration rate counting range: | TG-900P: 3 to 60 breaths/min |
| | TG-950P: 0 to 150 breaths/min |
| Respiration rate counting accuracy: | ±2 breaths/min |
| $N_2O$ anesthetic gas effect: | Accuracy in using $N_2O$ anesthetic gas is not guaranteed |
| $CO_2$ value display update cycle: | Every 3 s or when alarm is generated |
| Alarm: | |
| Upper limit range: | 2 to 99 mmHg in 1 mmHg steps, OFF |
| Lower limit range: | OFF, 1 to 98 mmHg in 1 mmHg steps |
| Apnea time: | OFF, 5 to 40 s |

### Gas (BSM-5135/5136 or when AG-920R multigas unit is connected)

| | |
|---|---|
| Measured gases: | $CO_2$ partial pressure, $N_2O$ concentration, $O_2$ concentration, anesthetic agent concentration (Halothane, Isoflurane, Enflurane, Sevoflurane, Desflurane), respiration rate |
| Warm-up time: | 45 seconds to first measurement |
| | 10 minutes to measurement with guaranteed accuracy |
| Sampling rate: | 70 to 200 mL/min (selectable) |
| $CO_2$ measurement: | |
| Measurement method: | Non-dispersive infrared ray absorption |
| Measuring range: | 0 to 76 mmHg |
| Measuring accuracy: | ±2 mmHg (0 to 40 mmHg) |
| | ±3 mmHg (40 to 55 mmHg) |
| | ±4 mmHg (55 to 76 mmHg) |
| Response time: | within 250 ms (10 to 90%) |
| Alarm: | Upper limit: $FiCO_2$: 1 to 5 mmHg in 1 mmHg steps, OFF |
| | $EtCO_2$: 2 to 99 mmHg in 1 mmHg steps, OFF |
| | Lower limit: $EtCO_2$: OFF, 1 to 98 mmHg in 1 mmHg steps |
| $N_2O$ measurement: | |
| Measurement method: | Non-dispersive infrared ray absorption |
| Measuring range: | 0 to 100% |
| Measuring accuracy: | ±3% |
| Response time: | within 250 ms (10 to 90%) |

Alarm ($FiN_2O$, $EtN_2O$): Upper limit: 1 to 100% in 1% steps, OFF
Lower limit: OFF, 0 to 99% in 1% steps

$O_2$ measurement:
- Measurement method: Paramagnetic
- Measuring range: 0 to 100%
- Measuring accuracy: ±2% (0 to 55%)
  ±3% (55 to 100%)
- Response time: within 500 ms (10 to 90%)
- Alarm: Upper limit: $FiO_2$: 19 to 100% in 1% steps, OFF
  $EtO_2$: 11 to 100% in 1% steps, OFF
  Lower limit: $FiO_2$: OFF, 18 to 99% in 1% steps
  $EtO_2$: OFF, 10 to 99% in 1% steps

Anesthetic agent measurement:
- Measurement method: Non-dispersive infrared ray absorption
- Measuring range: Halothane 0 to 5%
  Isoflurane 0 to 5%
  Enflurane 0 to 5%
  Sevoflurane 0 to 8%
  Desflurane 0 to 18%
- Measuring accuracy: ±0.2% (0 to 5%)
  ±0.4% (5 to 10%)
  ±0.6% (10 to 15%)
  ±1.0% (15 to 18%)

**NOTE**

**When alcohol or acetone is present in the respiration circuit, the unit gives inaccurate gas analysis data.**

- Response time: within 300 ms (10 to 90%) (Halothane, Isoflurane, Sevoflurane, Desflurane)
  within 500 ms (10 to 90%) (Enflurane)
- Alarm: Upper limit: FiAgent, EtAgent (HAL, ISO, SEV, ENF): 0.1 to 7.0% in 0.1% steps, OFF
  FiDES, EtDES: 0.1 to 20.0% in 0.1% steps, OFF
  Lower limit: FiAgent, EtAgent (HAL, ISO, SEV, ENF): OFF, 0.0 to 6.9% in 0.1% steps
  FiDES, EtDES: OFF, 0.0 to 19.9% in 0.1% steps

Respiration rate:
- Measuring range: 4 to 60 breaths/min
- Measuring accuracy: ±1 breath/min
- Alarm: Upper limit: 2 to 150 breaths/min in 2 breaths/min steps, OFF
  Lower limit: OFF, 0 to 148 breaths/min in 2 breaths/min
- Apnea time: OFF, 5 to 40 s in 5 s steps

### Trendgraph

Trend parameters: Heart rate (or pulse rate), respiration rate, VPC rate, ST level, EVENT, apnea (time), apnea (frequency), $SpO_2$, NIBP (systolic, diastolic and mean), IBP (systolic, diastolic and mean), temperature, $CO_2$, $FiO_2$ and anesthetic gas parameters

Trend times: 1, 2, 4, 8, 24 and 36 h

### Vital Signs List

Parameters: Heart rate (or pulse rate), VPC rate, ST level, NIBP (systolic, diastolic and mean), $SpO_2$, IBP (systolic, diastolic and mean), respiration rate, temperature, $CO_2$ and $FiO_2$ and anesthetic gas parameters

| | | |
|---|---|---|
| Number of files in list: | Periodic list: | 120 |
| | NIBP list: | 120 |
| List interval: | Periodic list: | 1, 5, 15, 30 or 60 minutes |
| | NIBP list: | at NIBP measurement |

**Full Disclosure**

| | |
|---|---|
| Storage time: | 30 hours |
| Number of storing parameters: | 5 maximum |

**Alarm History**

| | |
|---|---|
| Number of files: | 200 |

**Hemodynamics List**

| | |
|---|---|
| Number of files: | 8 |

**ECG/BP Output**

| | |
|---|---|
| Output impedance | |
| ECG: | ≤100 Ω |
| BP: | ≤100 Ω |
| Output-waveform | |
| ECG: | ±5.0 V (at 1 mV/V sensitivity) |
| BP: | –0.5 to +3.0 V(at 100 mmHg/V sensitivity) |
| Heart rate trigger: | Open collector output |
| Frequency response | |
| ECG: | 0.05 to 23 Hz (>–3 dB) |
| | (Differs in ECG display mode setting) |
| BP: | ≥DC to 20 Hz (>–3 dB) |
| Sensitivity accuracy | |
| ECG: | ±5% |
| BP: | ±5% (Excluding offset) |
| Delay | |
| ECG: | Hum filter off: approx. 2 ms |
| | Hum filter on: approx. 10 ms |
| BP: | 20 Hz filter: approx. 30 to 35 ms max |
| HT: | approx. 32 to 64 ms max |

**Recorder (option)**

| | |
|---|---|
| Recording method: | Thermal array recording |
| Number of channels: | 3 traces (maximum) |
| Recording width: | ≥48 mm |
| Paper speed: | 25, 50 mm/s |
| Recording paper: | FQW-50-3-100 |

**External Output**

| | |
|---|---|
| ZS-900PK: | Provided (BSM-5105K/5135K) |
| External monitor: | Provided |

**Clock Accuracy**

| | |
|---|---|
| At operating temperature 25°C: | about ±2 min 40 s/month maximum |
| At storage temperature –20 to 60°C: | about ±5 min/month maximum |

### Power Requirement

Required voltage:

| | |
|---|---|
| AC: | 100 to 240 V ±10% |
| DC (NKB-101): | 10.8 to 15.0 V ±5% |
| Line frequency: | 50 or 60 Hz ±2% |
| Power consumption: | 130 VA maximum |

### Environment

Operating environment

| | |
|---|---|
| Temperature: | 10 to 40°C |
| Humidity: | 30 to 90% RH (0 to 40°C, non-condensing) |
| Atmospheric pressure: | 70 to 106 kPa |

Storage environment

| | |
|---|---|
| Temperature: | –20 to +65°C |
| | –15 to +55°C (Recording paper) |
| Humidity: | 10 to 95% RH (0 to 40°C, non-condensing) |
| Atmospheric pressure: | 70 to 106 kPa |

### Dimensions and Weight (approximate)

| | |
|---|---|
| Dimensions: | 339 mm W × 315 mm H ×250 mm D |
| Weight: | BSM-5105/5106: 8 kg (excluding battery) |
| | BSM-5135/5136: 10 kg (excluding battery) |

### Electromagnetic Compatibility

IEC60601-1-2 (1993) – Collateral Standard: Electromagnetic compatibility – Requirement and tests

Emissions: CISPR11 Group 1, Class B

### Safety Standard

Safety standard: IEC 60601-1 (1988) Amendment 1 (1991), Amendment 2 (1995)
IEC 60601-2-27 (1994) - Particular requirements for the safety of electrocardiographic monitoring equipment
IEC 60601-2-25 (1993) - Particular requirements for the safety of electrocardiographs
IEC 60601-2-30 (1995) - Particular requirements for the safety of automatic cycling in in-direct blood pressure monitoring equipment
IEC 60601-2-34 (1994) - Particular requirements for the safety of direct blood pressure monitoring equipment

According to the type of protection against electrical shock:
CLASS I EQUIPMENT (AC Powered)
Internally Powered EQUIPMENT (BATTERY Powered)

According to the degree of protection against electrical shock

| | |
|---|---|
| ECG, Respiration (impedance), IBP, Temperature: | Defibrillator-proof type CF applied part |
| CO: | CF applied part |
| NIBP, $SpO_2$, Respiration (thermistor), $CO_2$, $FiO_2$, $N_2O$, agents: | Defibrillator-proof type BF applied part |

According to the degree of protection against harmful ingress of water:
IPX0 (ordinary EQUIPMENT)

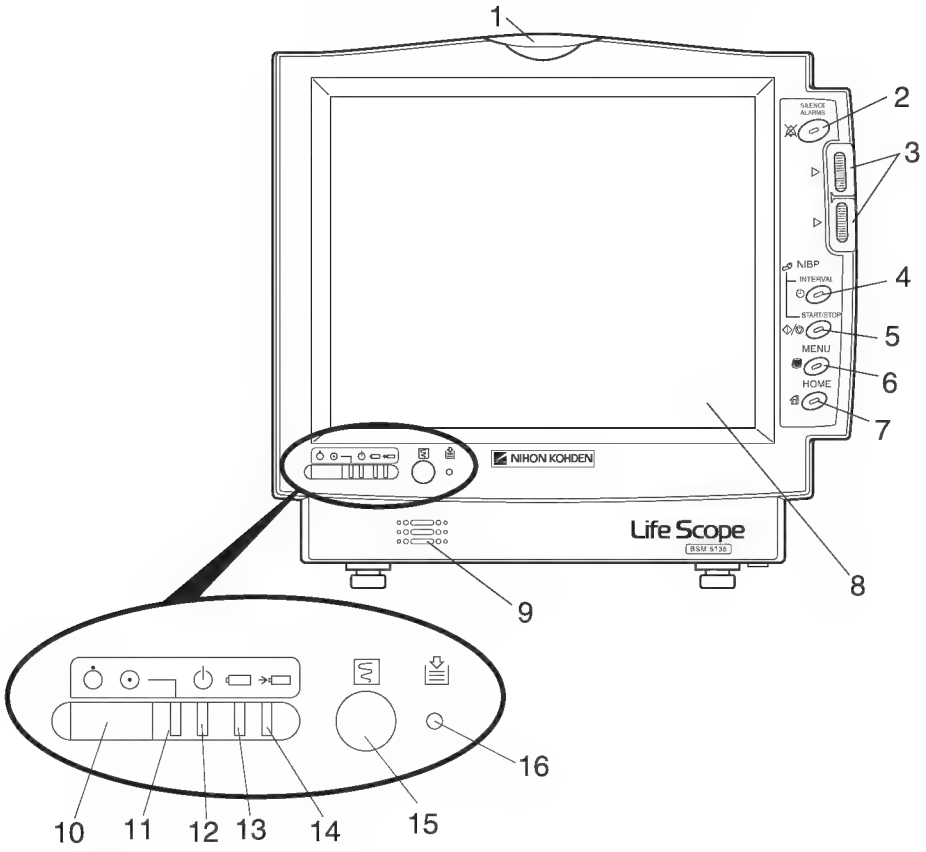
According to the degree of safety of application in the presence of FLAMMABLE ANAESTHETIC MIXTURE WITH AIR, OR WITH OXYGEN OR NITROUS OXIDE:

Equipment not suitable for use in the presence of FLAMMABLE ANAESTHETIC MIXTURE WITH AIR, OR WITH OXYGEN OR NITROUS OXIDE

According to the mode of operation: CONTINUOUS OPERATION

# Names and Function of Parts

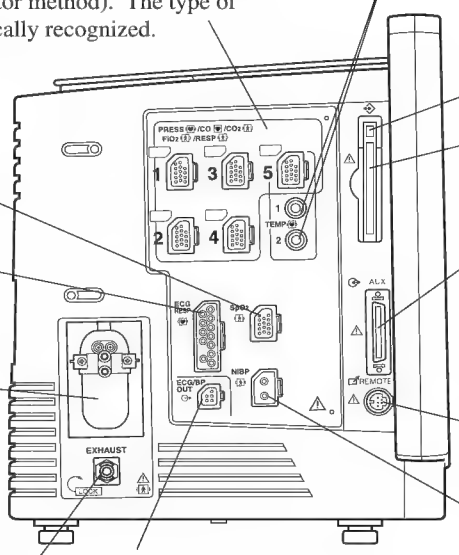
## Front Panel




| No. | Name | Description |
|---|---|---|
| 1 | Alarm indicator | Red or orange lamp blinks according to the alarm settings. Green lamp blinks in synchronization with the patient's QRS. |
| 2 | SILENCE ALARMS key | Silences the alarm sound. |
| 3 | Function dial 1 and 2 | Used for setting alarm limits and scrolling list or trendgraphs. When the function dial lamp lights, the function dial is available. |
| 4 | NIBP INTERVAL key | Selects NIBP measurement mode. Pressing this key changes the mode. |
| 5 | NIBP START/STOP key | Starts NIBP measurement in selected mode. Pressing the key during measurement stops measurement. |
| 6 | MENU key | Displays the MENU window. |
| 7 | HOME key | Closes all opened windows and displays the monitoring screen. |
| 8 | Touch screen | Displays monitoring data. Touching a key or data on the screen changes the displayed screen and settings. |
| 9 | Speaker | For alarm and sync sound. |
| 10 | Power switch | Press and hold for more than one second to turn the monitor power on or off. |
| 11 | Power lamp | Lights when the monitor power is turned on. |
| 12 | AC power lamp | Lights when the power cord is connected between the AC SOURCE socket and AC outlet. |
| 13 | Battery power lamp | Lights when operating on battery power. |
| 14 | Battery charging lamp | Lights or slowly blinks when charging. |
| 15 | Record key (option) | Press to start or stop recording. |
| 16 | Out of paper lamp (option) | Blinks when out of paper. Lights when the recorder door is open. |

## Left Side Panel

### On the BSM-5105/5135 Monitors



**Multi-parameter sockets**
Connects to the connection cord of the parameter to be monitored (IBP, temperature, CO, $CO_2$, $FiO_2$ or respiration by thermistor method). The type of parameter is automatically recognized.

**TEMP jacks**
Connects to the temperature probe cord.

**PC card eject button**

**PC card slot**
For an optional QI-101P network card or a QI-111P network printer card.

**$SpO_2$ socket**
Connects to the $SpO_2$ connection cord.

**ECG/RESP socket**
Connects to the ECG connection cord.

**AUX socket**
For connecting a display monitor with a YS-072P5 connection cable, an AG-920R multigas unit with a YJ-921P connection cable or QI-400P series interface.

**Dryline receptacle (on BSM-5135 only)**
For attaching the dryline.

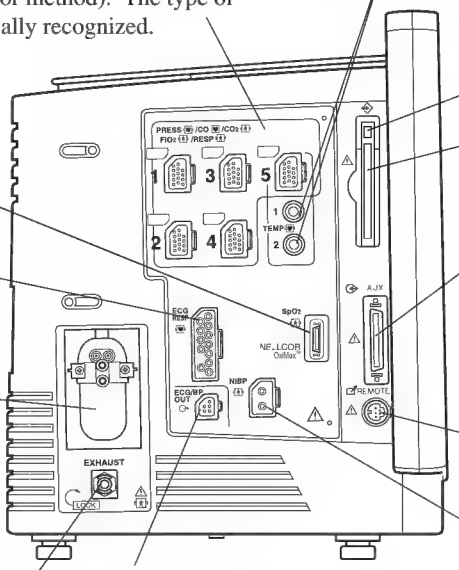
**REMOTE socket**
Not available.

**NIBP socket**
Connects to the air hose.

**Sampling gas exhaust outlet (on BSM-5135 only)**
Connects to an anesthetic machine to exhaust gas.

**ECG/BP OUT socket**
Outputs 100 mmHg/V IBP waveform of the IBP connected to the multi-parameter 1 socket, 1 mV/V ECG waveform and heart rate trigger by using the YJ-910P or YJ-920P ECG/BP output cable. These analog signals can be used as the synchronization signal for other equipment, such as IABP. Refer to the warning and note on the next page.

### On the BSM-5106/5136 Monitors



**Multi-parameter sockets**
Connects to the connection cord of the parameter to be monitored (IBP, temperature, CO, $CO_2$, $FiO_2$ or respiration by thermistor method). The type of parameter is automatically recognized.

**TEMP jacks**
Connects to the temperature probe cord.

**PC card eject button**

**PC card slot**
For an optional QI-101P network card or a QI-111P network printer card.

**$SpO_2$ socket**
Connects to the $SpO_2$ connection cord.

**ECG/RESP socket**
Connects to the ECG connection cord.

**AUX socket**
For connecting a display monitor with a YS-072P5 connection cable, an AG-920R multigas unit with a YJ-921P connection cable or QI-400P series interface.

**Dryline receptacle (on BSM-5136 only)**
For attaching the dryline.

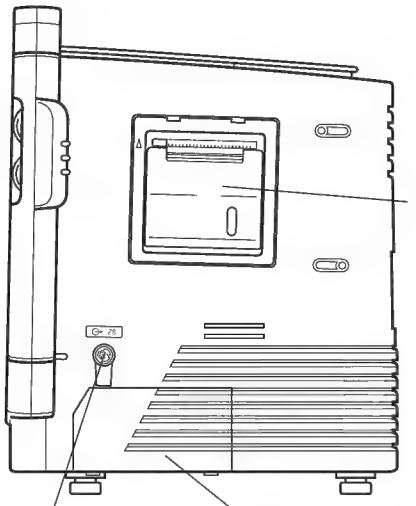
**REMOTE socket**
Not available.

**NIBP socket**
Connects to the air hose.

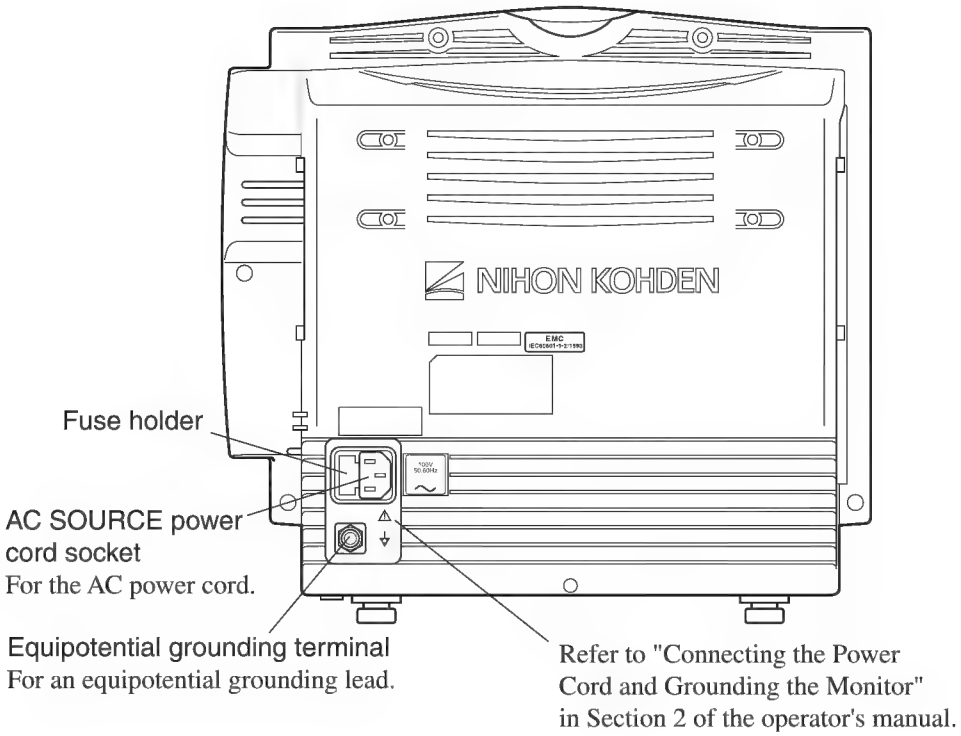
**Sampling gas exhaust outlet (on BSM-5136 only)**
Connects to an anesthetic machine to exhaust gas.

**ECG/BP OUT socket**
Outputs 100 mmHg/V IBP waveform of the IBP connected to the multi-parameter 1 socket, 1 mV/V ECG waveform and heart rate trigger by using the YJ-910P or YJ-920P ECG/BP output cable. These analog signals can be used as the synchronization signal for other equipment, such as IABP. Refer to the warning and note on the next page.

## Right Side Panel




## Rear Panel


NIHON KOHDEN
Fuse holder
AC SOURCE power cord socket
For the AC power cord.
Equipotential grounding terminal
For an equipotential grounding lead.
Refer to "Connecting the Power Cord and Grounding the Monitor" in Section 2 of the operator's manual.

# Storage and Transport

Follow these procedures when storing or transporting the instrument.

## Storage

Before storing the instrument for a long time, perform the following steps:

1. Disconnect the power cord from the instrument.
2. Cover the instrument with a dust cover.
3. If possible, store the instrument in its original shipping container.
4. Make sure the storage place meets the following storage conditions for the duration of the storage.
   Storage temperature: –20 to 60°C (–4 to 130°F)
   Storage humidity: 10 to 95% RH, non-condensing

## Transport

To transport the instrument, perform the following steps:

1. Disconnect the power cord from the instrument.
2. Cover the instrument with a dust cover.
3. If possible, transport the instrument in its original shipping container.

# Hard Keys and Soft Keys

## Hard Keys

The instrument has six hard keys: SILENCE ALARMS, NIBP INTERVAL, NIBP START/STOP, MENU, HOME and RECORD.
These keys always have the same functions, regardless of the screen display.
In this manual, hard keys are indicated by CAPITAL LETTERS.

## Soft Keys

When the MENU key is pressed or the screen is touched, the screen displays several keys which have different functions depending on the screen display. For example, when the HR numeric display is touched, the ECG setting screen appears and several keys such as VITAL ALARM, ARRHYTH ALARM, OTHER SETTING, etc are displayed.
In this manual, soft keys are indicated by quotation marks (for example, the "VITAL ALARM" key).

# Upgrading the System Software and Changing Language on the Screen

**CAUTION**

**Upgrading the system software and changing the language on screen erases all system and monitoring settings. Write down these settings so they can be re-entered after the software upgrade.**

The instrument uses a program card for upgrading its system software and changing the screen language. When the instrument detects that a program card is inserted into its PC card slot during the booting stage after it is turned on, it checks the program card for a system program or language. If the program card contains a newer version of the system program or language, the instrument automatically replaces its current system program or language information with the new one. If the program card contains a system program whose version number is the same or older than the one in the instrument, you have the option to replace or keep the current system program. If the program card does not contain a system program, the instrument continues the boot-up process.

In the system software upgrading or language changing process, the instrument first deletes the old system software or language stored in its system ROM. Then it checks whether the data in the system ROM is completely deleted. When the data is completely deleted, it copies the new version of the system program or language information from the program card to the system ROM and then checks the copy process. After the data is successfully copied, it performs the self-check programs to check the equipment.

### Procedure

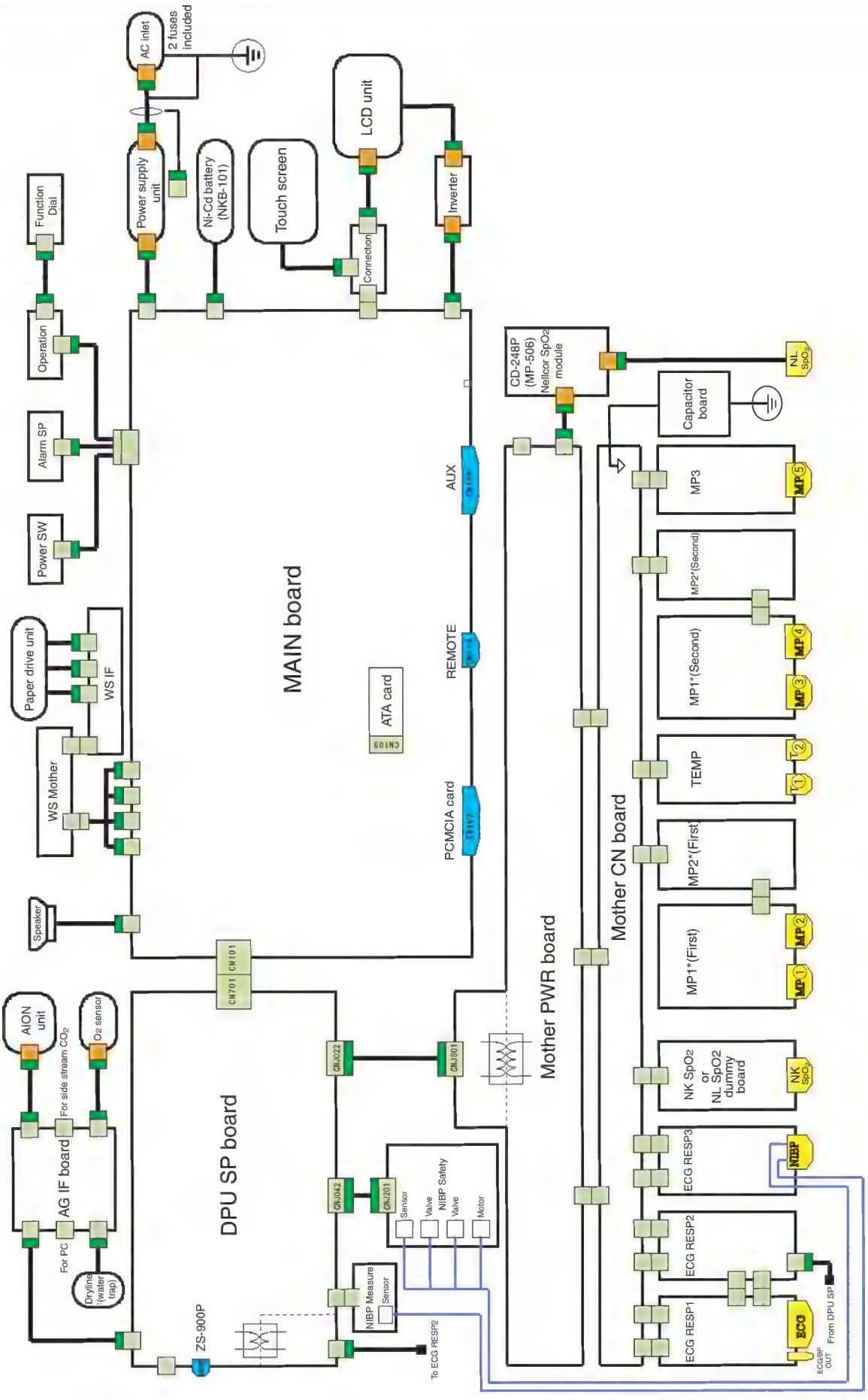
1. Write down the System Setup settings and monitoring settings of the instrument.

2. Insert the program card into the PC card slot on the left side panel of the instrument.

3. Turn on the instrument. The instrument performs the upgrading process and self-check programs. The DIAGNOSTIC CHECK screen appears.

4. Confirm that the new system software version number appears.

# Board/Unit Connection Diagram




*There are two MP1 boards and two MP2 boards. The first MP1 board has two input sockets No. 1 and 2. The second one has two input sockets No. 3 and 4.

# *Section 2 Troubleshooting*


General ..... 2.1
Power-Related Problems ..... 2.2
Display Problems ..... 2.3
Sound Problems ..... 2.4
Key Operation Problems ..... 2.4
Recording Problems ..... 2.5
ECG and Respiration by Impedance Method Problems ..... 2.6
$SpO_2$ Problems ..... 2.7
Non-invasive Blood Pressure Problems ..... 2.8
Other Vital Sign Input Problems ..... 2.9
ECG/BP Output Problems ..... 2.14
Option Problems ..... 2.15

# General

Use the troubleshooting tables to locate, identify, and solve a problem in the instrument. The problems are divided into general problem areas. Each category has its own troubleshooting table for fast and easy troubleshooting.

- Power-related Problems
- Display Problems
- Sound Problems
- Key Function Problems
- Recording Problems
- ECG and Respiration by Impedance Method Problems
- $SpO_2$ Problems
- NIBP Problems
- Other Vital Sign Input Problems
- ECG/BP Output Problems
- Option Problems

If these sections do not solve the problem, contact your Nihon Kohden representative.

**NOTE**

**Before contacting your Nihon Kohden representative for technical support, please provide additional detailed information on the problem. This will allow your Nihon Kohden representative to provide you with the best support.**

### How to use the troubleshooting table

1. Determine which troubleshooting table to use.
2. In the "Problem" column, find the trouble item that matches the problem.
3. Do the action recommended in the "Action" column.
4. If the problem is not solved, do the action for the next possible cause or criteria.
5. If none of the actions solve the problem, contact your Nihon Kohden representative.

# Power-Related Problems

| Problem | Possible Cause/Criteria | Action |
|---|---|---|
| No beep sound and AC power lamp does not light in AC power operation. | No AC power input. | Check the AC power input. |
| | One or both AC inlet fuses is blown. | Remove the cause of the blown fuse, then replace the fuse. |
| | Faulty connection between CN105 on the MAIN board and power unit. | Check the connection of MAIN board and power unit. |
| | Faulty connection between CN103 on the MAIN board and power SW board. | Check the connection. |
| | Faulty power supply unit. | Replace the power supply unit. |
| | Faulty power SW board. | Replace the power SW board. |
| No beep sound and the battery power lamp does not light in DC power operation. | The battery is discharged. | Charge the battery before use. |
| | The battery is damaged. | Replace the battery. |
| | Faulty cable connection between CN021 on the MAIN board and battery receptacle terminals. | Check the connection. |
| DC power operation time is shorter than expected. | The battery is near the end of its life (about 1 year). | Replace the battery with a new one. |
| | Poor contact between the battery and its contact points in the battery compartment. | Clean the contact points between the battery and its compartment terminals. |
| | The battery has had "memory effect" in which its charge capacity is decreased by frequent incomplete discharging and charging. | To clear this "memory effect", fully discharge the battery and then fully charge it a few times. |
| | | Replace the battery with a new one. |
| Power switch is not operational. | Faulty power SW board. | Replace the power SW board. |
| | Faulty MAIN board. | Replace the MAIN board. |

# Display Problems

| Problem | Possible Cause/Criteria | Action |
|---|---|---|
| No display and the backlight does not light. | Faulty connection between CN108 on the MAIN board and inverter. | Check the connections. |
| | Faulty connection between inverter and LCD unit. | Check the connections. |
| | Faulty inverter board. | Replace the inverter board. |
| | Faulty backlight lamps. | Replace the backlight lamps. |
| No display, but the backlight lights. | Faulty connection between CN102 on the MAIN board and CN102 on the connection board. | Check the connection. |
| | Faulty connection between CN103 on the connection board and LCD unit. | Check the connection. |
| | Faulty LCD unit. | Replace the LCD unit. |
| | Faulty MAIN board. | Replace the MAIN board. |
| Fine vertical or horizontal lines on the LCD. | Faulty LCD unit. | Replace the LCD unit. |
| | Faulty MAIN board. | Replace the MAIN board. |
| Thick vertical or horizontal stripes on the screen. | Faulty MAIN board. | Replace MAIN board. |
| The characters or waveforms are distorted. | Faulty MAIN board. | Replace the MAIN board. |
| | Faulty connection between CN102 on the MAIN board, connection board and LCD. | Check the connection. |
| The display is dim and the brightness control does not make it brighter. | Battery operation. | Set the POWER SAVE MODE to OFF on the SYSTEM SETUP screen. |
| | Dirt on the touch screen (inside or outside). | Clean the surface of touch screen. |
| | The backlight lamps are near the end of its useful life (25,000 hours of operation). | Replace the backlight lamps. |
| | Faulty connection between CN108 on the MAIN board and inverter board. | Check the connection. |
| The Diagnostic Check screen appears in the monitor mode and "OK" is displayed at the POWER ON CHECK RESULT. | Faulty Operation board. | Replace the Operation board. |
| | Faulty MAIN board. | Replace the MAIN board. |
| The Diagnostic Check screen appears in the monitor mode and an error message is displayed at the POWER ON CHECK RESULT. Refer to "Power On Self Check" in Section 3. | Faulty MAIN board. | Replace the MAIN board. |
| | Faulty DPU SP board. | Replace the DPU SP board. |
| The screen with a "Check Program Running" message does not change to the next screen after the power is turned on. | Software bug. | Perform the system initialization. |
| | Faulty MAIN board. | Replace the MAIN board. |
| | Faulty DPU SP board. | Replace the DPU SP board. |
| System error information appears at the upper left corner on the screen in the monitor mode and the instrument restarts. | Faulty MAIN board. | Replace the MAIN board. |
| | Faulty DPU SP board. | Replace the DPU SP board. |
| More than 25 pixels on the screen do not light or have abnormal color. Note that up to 25 pixels with such a problem is considered normal. | Faulty LCD unit. | Replace the LCD unit. |
| No waveform is displayed but the connection cord for each vital sign is recognized. | Faulty MAIN board. | Replace the MAIN board. |
| No waveform is displayed and the connection cord for each vital sign is not recognized. | Refer to each vital sign troubleshooting section. | Refer to each vital sign troubleshooting section. |

## Sound Problems

| Problem | Possible Cause/Criteria | Action |
|---|---|---|
| No sound. | Faulty connection between CN006 on the MAIN board and the speaker. | Check the connection. |
| | Faulty speaker. | Replace the speaker. |
| | Faulty MAIN board. | Replace the MAIN board. |
| No sound, except for a hissing sound. | Faulty MAIN board. | Replace the MAIN board. |
| | Faulty speaker. | Replace the speaker. |
| The sound is muffled or distorted. | The speaker is blocked. | Remove the object blocking the speaker. |
| | Something foreign is touching the speaker. | Remove the foreign matter. |
| | The speaker is wrongly attached. | Attach the speaker correctly. |

## Key Operation Problems

| Problem | Possible Cause/Criteria | | Action |
|---|---|---|---|
| No key on the front panel works. | Faulty connection between CN102 on the Operation board and CN103 on the MAIN board. | | Check the connection. |
| | Faulty MAIN board. | | Replace the MAIN board. |
| | Faulty Operation board. | | Replace the Operation board. |
| A specified key on the operation panel does not work. | Faulty connection cable between CN102 on the Operation board and CN103 on the MAIN board. | | Replace the connection cable. |
| | Faulty Operation board. | | Replace the Operation board. |
| | Faulty MAIN board. | | Replace the MAIN board. |
| The workable key area does not match the key display on the screen. | Incorrect calibration of the touch screen. | | Calibrate the touch screen positioning. |
| | Faulty connection between the touch screen and Connection board. | | Check the connection. |
| | Faulty connection between connection board and MAIN board. | | Check the connection. |
| Touch screen does not work. | The key function on the entire screen does not work. | Faulty connection between the touch screen and CN102 on the Connection board. | Check the connection. |
| | | Faulty MAIN board. | Replace the MAIN board. |
| | | Faulty touch screen. | Replace the touch screen. |
| | The key function on a partial screen such as upper half screen does not work | Faulty touch screen. | Replace the touch screen. |
| Function dials are not operational. | Faulty connection between the Operation board and Function Dial board. | | Check the connection. |
| | Faulty Function Dial board. | | Replace the Function Dial board. |
| | Faulty MAIN board. | | Replace the MAIN board. |

# Recording Problems

| Problem | Possible Cause/Criteria | | Action |
|---|---|---|---|
| Recording paper does not feed properly. | Recording mark does not appear on the screen when the record key is pressed. | Faulty connection between CN103 on the MAIN board and Power SW board. | Check the connection. |
| | | Faulty Power SW board. | Replace the Power SW board. |
| | | Faulty MAIN board. | Replace the MAIN board. |
| | Paper magazine open mark appears on the screen. | Faulty connection between CN122 on the MAIN board and recorder unit | Check the connection. |
| | | Faulty magazine position sensing micro switch of the recorder unit. | Replace the micro switch. Refer to Section 8 "Replaceable Parts List". |
| | | Faulty MAIN board. | Replace the MAIN board. |
| | Out of paper mark appears on the screen. | Faulty connection between CN122 on the MAIN board and recorder unit. | Check the connection. |
| | | Faulty paper detection photo sensor or LED of the reorder unit. | Replace the photo sensor and LED. Refer to Section 8 "Replaceable Parts List". |
| | | Faulty MAIN board. | Replace the MAIN board. |
| | Recording can be performed when the paper is manually pulled out after the record key is pressed. | Faulty connection between CN122 on the MAIN board and recorder unit. | Check the connection. |
| | | Faulty paper drive motor of the recorder unit. | Replace the motor. Refer to Section 8 "Replaceable Parts List". |
| | | Faulty MAIN board. | Replace the MAIN board. |
| For page-dependent recording such as trendgraph and vital sign list, the recording does not start at the top of the page | Wrong position of the recording paper in the magazine. | | Load the paper into the magazine correctly. |
| | Paper other than Nihon Kohden is used. | | Use the Nihon Kohden paper. |
| | Photo sensor for detection of the black square on the paper is dirty. | | Clean the sensor. |
| | Faulty connection between CN122 on the MAIN board and recorder unit. | | Check the connection. |
| | Faulty black square detection photo sensor or LED of the recorder unit. | | Replace the photo sensor and LED. Refer to Section 8 "Replaceable Parts List". |
| | Faulty MAIN board. | | Replace the MAIN board. |
| The recorded data such as waveform and grid has a faint part on the paper. | Thermal array head is dirty | | Clean the head. |
| | Paper other than Nihon Kohden is used. | | Use the Nihon Kohden paper. |
| | Platen roller has a damage or is deformed. | | Replace the roller. |
| | The supply voltage for thermal array head (+24 V DC) decreases. | | Replace the MAIN board. |
| There is missing dots on the recorded data. | Faulty thermal array head if the dots are missed at the same position on the paper after the head is cleaned. | | Replace the head. |
| Straight line is recorded at the same position on the paper. | Faulty thermal array head or recorder unit after head is cleaned. | | Replace the head or recorder unit. |
| There is different contrast between the upper half and lower half of the paper. | The thermal array head is incompletely attached to the recorder unit. | | Attach the head correctly. |
| The paper speed is unstable and waveform is compressed or extended on time scale. | Dirty gear or platen roller. | | Clean the gear and platen roller. |
| | Faulty gear or platen roller | | Replace the faulty one. |
| | Unstable turn of the paper drive motor | Faulty MAIN board | Replace the MAIN board. |
| | | Faulty motor | Replace the motor. |
| Abnormally loud rotating sound of the paper drive motor | Faulty gear or platen roller | | Replace the faulty one. |
| No recording on the paper | The heat-sensitive side of the paper is not faced to the thermal array head. | | Load the paper into the magazine correctly. |
| | Paper other than Nihon Kohden is used. | | Use the Nihon Kohden paper. |
| | Faulty connection between CN121 on the MAIN board and recorder unit. | | Check the connection. |
| | The supply voltage for thermal array head (+24 V DC) decreases. | | Replace the MAIN board. |
| | Faulty thermal array head. | | Replace the head. |

# ECG and Respiration by Impedance Method Problems

| Problem | Possible Cause/Criteria | Action |
|---|---|---|
| ATTACH ELECTRODES message is displayed even after each electrode contact part of the electrode lead is short-circuited. | The setting, Number of electrodes, is set to a higher number than the actual number of the electrodes. | Set the number of electrodes correctly. |
| | The electrode lead, ECG connection cord or patient cable is faulty. | Replace the accessory with a new one. |
| | ECG RESP1 board, ECG RESP2 board or ECG RESP3 board is faulty. | Replace the ECG input block with a new one*. |
| The time constant setting cannot be changed. | The ECG RESP3 board is faulty if the monitoring lead setting can be changed. | Replace the ECG input block with a new one*. |
| | Motherboard, DPU SP board or ECG RESP3 board is faulty if the monitoring lead setting cannot be changed. | Replace the ECG input block or DPU SP board with a new one*. |
| Pacing spike is not detected. | ECG RESP2 board, motherboard or DPU SP board is faulty if the pacing spike detection setting, PACING REJECT, is set to on. | Replace the ECG input block or DPU SP board with a new one*. |
| | ECG RESP3 board is faulty if the pacemaker rhythm is not recognized in the 12 lead ECG interpretation. | Replace the ECG input block with a new one*. |
| The ECG waveform is displayed with a different ECG sensitivity from the sensitivity setting. | ECG RESP1 board is faulty if the ECG waveform at a specified lead is displayed with a different sensitivity from the sensitivity setting. | Replace the ECG input block with a new one*. |
| | ECG RESP2 board or ECG RESP3 board is faulty if the ECG waveform at all the leads is displayed with a different sensitivity from the sensitivity setting. | |
| Monitoring lead setting cannot be changed but the time constant setting can be changed. | ECG RESP1 board, ECG RESP2 board or ECG RESP3 board is faulty. | Replace the ECG input block with a new one*. |
| Display of 12 lead ECG has something wrong. | ECG RESP3 board or motherboard is faulty if no 12 lead ECG waveforms are displayed in the 12 LEAD window. | Replace the ECG input block with a new one*. |
| | ECG RESP1 board, ECG RESP2 board or ECG RESP3 board is faulty if a specified lead of the 12 lead ECG waveforms is not displayed in the 12 LEAD window | |
| Respiration waveform is not displayed. | Electrode, electrode lead, ECG connection cord or patient cable is faulty if the ECG waveform on the screen has something wrong. | Replace the accessory with a new one. |
| | ECG RESP1 board, ECG RESP2 board, motherboard or DPU SP board is faulty if the ECG waveform on the screen has nothing wrong. | Replace the ECG input block or DPU SP board with a new one*. |
| Respiration rate is wrong and the respiration sensitivity is out of control. | ECG RESP1 board or ECG RESP2 board is faulty. | Replace the ECG input block with a new one*. |
| ECG waveform and respiration waveform are mixed. | Motherboard or DPU SP board is faulty. | Replace the ECG input block or DPU SP board with a new one*. |
| Respiration waveform is saturated and does not return to the baseline position but the sensitivity is not too high. | ECG RESP2 board is faulty. | Replace the ECG input block with a new one*. |

* ECG input block repair kit is required when one of the ECG RESP1, ECG RESP2, ECG RESP3 and mother PWR boards has a failure. Refer to "Board Compatibility" in Section10 "Internal Switch Setting and Board Compatibility".

# $SpO_2$ Problems

| Problem | Possible Cause/Criteria | Action |
|---|---|---|
| The instrument does not recognize the NK SpO2 connection cord connected to the SpO2 socket on the instrument. | NK SpO2 board or motherboard is faulty or contact between them is poor if the ECG, impedance method respiration and NIBP measurements are enabled. | Check the connection. Replace the NK SpO2 board or ECG input block with a new one* if the connection has no problem. |
| | DPU SP board is faulty if the ECG, impedance method respiration and NIBP measurements are disabled. | Replace the faulty board with a new one. |
| PULSE SEARCH message is displayed even after the probe is replaced and attachment site is changed. | NK SpO2 board is faulty. | Replace the faulty board with a new one. |
| WEAK PULSE message is displayed even after the probe is replaced and attachment site is changed. | NK SpO2 board is faulty. | Replace the faulty board with a new one. |
| SpO2 MODULE ERROR message is displayed. | SpO2 module (Nellcor) is faulty or connection between the motherboard and SpO2 module is poor if this error message is displayed, except in the following case. | Check the connection. Replace the faulty module with a new one if the connection has no problem. |
| | If the Nellcor SpO2 connection cord is connected to or disconnected from the SpO2 socket just after the instrument is turned on, it displays this error message at the power on check. | Connect the SpO2 connection cord and turn off the instrument. Turn on the instrument 10 seconds or more after the power is turned off. |

* ECG input block repair kit is required when one of the ECG RESP1, ECG RESP2, ECG RESP3 and mother PWR boards has a failure. Refer to “Board Compatibility” in Section10 “Internal Switch Setting and Board Compatibility”.

# Non-invasive Blood Pressure Problems

| Problem | Possible Cause/Criteria | Action |
|---|---|---|
| NIBP MODULE FAILURE message is displayed. | DPU SPboard or NIBP Safety board is faulty. | Replace the faulty board with a new one. |
| NIBP SAFETY CIRCUIT RUNNING message is displayed. | Air hose is blocked. | Check the air hose. |
| | Air tube between the NIBP Safety board and NIBP socket is blocked or NIBP Safety board or DPU SP board is faulty if this message appears soon after the NIBP START/STOP key is pressed and NIBP pump sounds like it's moving. | Check the air tube connection. Replace the faulty board with a new one if the air tube is not blocked. |
| | Air tube between the NIBP Measure board and NIBP socket is blocked or NIBP Safety board or DPU SP board is faulty if this message appears in a minute after the NIBP START/STOP key is pressed and NIBP pump sounds like it's moving. | |
| AIR LEAK message is displayed. | Cuff or air hose has an air leak. | Replace the cuff or air hose with a new one. |
| | Air tube between the NIBP Safety board and NIBP socket is loose or disconnected if the cuff is not inflated when the NIBP pump sounds like it's moving. | Check the air tube connection. |
| | Air tube between the NIBP Measure board and NIBP socket is loose or disconnected or NIBP Safety board is faulty if the cuff is inflated when the NIBP pump sounds like it's moving. | Check the air tube connection. Replace the faulty board with a new one if the air tube connection has no problem. |
| The instrument does not recognize the air hose connected to the NIBP socket on the instrument. | The air hose connector is faulty. | Replace the air hose with a new one. |
| | ECG RESP3 board or NIBP Safety board is faulty or there is poor contact from the ECG RESP3 board to NIBP Safety board if the ECG and impedance method respiration can be measured. | Check the connection from ECG RESP3 board to NIBP Safety board through the motherboard and SP DPU board. Replace the faulty board with a new one if the connection has no problem. |
| | ECG RESP3 board, motherboard or DPU SP board is faulty or there is a poor contact from the ECG RESP3 board to DPU SP board if the ECG and impedance method respiration cannot be measured. | Check the connection from the ECG RESP3 board to DPU SP board through the motherboard. Replace the faulty board with a new one if the connection has no problem. |
| NIBP measurement data on the screen is wrong. | A wrong cuff size is used or the condition of the cuff wrapped around the patient's arm is not correct. | Check the cuff size and the wrapping condition. |
| | DPU SP board is faulty if the ECG, impedance method respiration and $SpO_2$ cannot be measured. | Replace the faulty board with a new one. |
| | NIBP Measure board or DPU SP board is faulty or there is a poor contact between the two boards if the ECG, impedance method respiration and $SpO_2$ can be measured. | Check the connection between the two boards. Replace the faulty board with a new one if the connection has no problem. |
| The cuff does not inflate when the NIBP START/STOP key is pressed. | If a message is displayed on the screen, follow the message to solve the problem. | Refer to ERROR MESSAGES AND TROUBLESHOOTING section in the operator's manual. |
| | The Operation board, MAIN board or the cable between the two boards is disconnected if there is no message on the screen. | Check the cable connection. Replace the faulty board with a new one if the cable connection has no problem. |

# Other Vital Sign Input Problems

| Problem | Possible Cause/Criteria | Action |
|---|---|---|
| The instrument does not recognize a connection cord at a multi-parameter socket. | The connection cord has a failure. | Replace the connection cord with a new one. |
| | The first MP1 board or first MP2 board has a failure if the connection cord is not recognized at the No. 1 and/or No. 2 multi-parameter socket(s). | Replace the board with a new one. |
| | The second MP2 board has a failure if the connection cord is not recognized at the No. 3, No. 4 and No. 5 multi-parameter sockets. | |
| | The MP3 board or second MP2 board has a failure if the connection cord is not recognized at the No. 5 multi-parameter socket only. | |
| | The second MP1 board or second MP2 board has a failure if the connection cord is not recognized at the No. 3 and/or No. 4 multi-parameter socket(s). | |
| The instrument does not recognize a temperature probe at a multi-parameter socket and/or at the TEMP jacks. | The temperature probe has a failure. | Replace the probe with a new one. |
| | The first MP1 board or first MP2 board has a failure if the temperature probe is not recognized at the No. 1 or No. 2 multi-parameter socket through the connection cord. | Replace the board with a new one. |
| | The TEMP board or first MP2 board has a failure if the temperature probe is not recognized at the TEMP jacks. | |
| | The first MP2 board has a failure if the temperature probe is not recognized at the No. 1 and No. 2 multi-parameter sockets through the connection cord and at the TEMP jacks. | Replace the MP2 board with a new one. |
| MPU MODULE ERROR message is displayed. | The cable between the mother PWR and DPU SP boards is disconnected. | Check the cable connection. |
| | The first or second MP2 board, mother PWR board or DPU SP board has a failure if this message always appears even after the instrument is turned off and on again. | Replace the MP2 board, ECG input block or DPU SP board with a new one*. |
| | The first or second MP2 board has a failure if this message sometimes appears after the instrument is turned off and on again. | Replace the board with a new one. |
| MPU FAILURE message is displayed. | The EEPROM in the connector of the connection cord has a failure if connecting the cord to any multi-parameter sockets causes this message. | Replace the connection cord with a new one. |
| | The TEMP board or first MP2 board has a failure if connecting the temperature probe to the TEMP jacks only causes this message. | Replace the board with a new one. |
| | The first MP1 board or first MP2 board has a failure if connecting the cord to the No. 1 or No. 2 multi-parameter socket causes this message. | |
| | The MP3 board or second MP2 board has a failure if connecting the cord to the No. 5 multi-parameter socket causes this message. | |
| | The second MP1 board or second MP2 board has a failure if connecting the cord to the No. 3 or No. 4 multi-parameter socket causes this message. | |
| No input parameters for the multi-parameter socket can be measured at the No. 1 and No. 2 (and TEMP jacks in temperature measurement) or at the No. 3 to No. 5 multi-parameter sockets. | The first MP2 board has a failure if the input parameter cannot be measured at the No. 1 and No. 2 multi-parameter sockets (and TEMP jacks in case of the temperature) but there is no error message on the screen when the connection cord is connected to the multi-parameter sockets. | Replace the MP2 board with a new one. |
| | The second MP2 board has a failure if the input parameter cannot be measured at the No. 3, No. 4 and No. 5 multi-parameter sockets but there is no error message on the screen when the connection cord is connected to the multi-parameter sockets. | |

* ECG input block repair kit is required when one of the ECG RESP1, ECG RESP2, ECG RESP3 and mother PWR boards has a failure. Refer to "Board Compatibility" in Section10 "Internal Switch Setting and Board Compatibility".

| Problem | Possible Cause/Criteria | Action |
|---|---|---|
| Invasive blood pressure cannot be measured. | The blood pressure transducer or connection cord has a failure. | Replace the transducer or cord with a new one. |
| | The first MP1 board or first MP2 board has a failure if the blood pressure cannot be measured at the No. 1 and No. 2 multi-parameter sockets. | Replace the board with a new one. |
| | The second MP1 board or second MP2 board has a failure if the blood pressure cannot be measured at the No. 3, No. 4 and No. 5 multi-parameter sockets. | |
| | The MP3 board, second MP2 board or mother CN board has a failure if the blood pressure cannot be measured at the No. 5 multi-parameter socket only. | |
| | The second MP1 board or second MP2 board has a failure if the blood pressure cannot be measured at the No. 3 and/or No. 4 multi-parameter socket(s). | |
| CHECK SENSOR message is displayed in IBP measurement. | The blood pressure transducer has a failure. | Replace the transducer with a new one. |
| | The first MP1 board or first MP2 board has a failure if connecting the normal transducer to the No. 1 or No. 2 multi-parameter socket through the connection cord causes this message. | Replace the board with a new one. |
| | The second MP1 board or second MP2 board has a failure if connecting the normal transducer to the No. 3, No. 4 or No.5 multi-parameter socket through the connection cord causes this message. | |
| | The MP3 board or second MP1 board mother CN board has a failure if connecting the normal transducer to the No. 5 multi-parameter socket causes this message. | |
| | The second MP2 board has a failure if connecting the normal transducer to any of the No. 3 or No. 4 multi-parameter sockets through the connection cord causes this message. | |
| IBP measurement data on the screen is wrong. | The blood pressure transducer has a failure. | Replace the transducer with a new one. |
| | The first MP2 board or first MP1 board has a failure if the blood pressure data is wrong at the No. 1 and No. 2 multi-parameter sockets, and the temperature, FiO2 and respiration rate (thermistor method) are acceptable at the same multi-parameter sockets. | Replace the board with a new one. |
| | The first MP2 board has a failure if not only the blood pressure data but also temperature, FiO2 and respiration rate (thermistor method) are wrong at the No. 1 and No. 2 multi-parameter sockets. | |
| | The first MP1 board has a failure if the blood pressure data is wrong at the No. 1 or No. 2 multi-parameter socket. | |
| | The second MP2 board or second MP1 board has a failure if the blood pressure data is wrong at the No. 3, No. 4 and No. 5 multi-parameter sockets, and the temperature, FiO2 and respiration rate (thermistor method) are acceptable at the same multi-parameter sockets. | |
| | The second MP2 board has a failure if not only the blood pressure data but also temperature, FiO2 and respiration rate are wrong at the No. 3, No. 4 and No. 5 multi-parameter sockets. | |
| | The second MP1 board has a failure if the blood pressure data is wrong at the No. 3 or No. 4 multi-parameter socket. | |
| | The MP3 board has a failure if the blood pressure data is wrong at the No. 5 multi-parameter socket only. | |

| Problem | Possible Cause/Criteria | Action |
|---|---|---|
| Temperature cannot be measured. | The thermistor probe has a failure. | Replace the probe with a new one. |
| | The first MP2 board or TEMP board has a failure if the temperature cannot be measured at the No. 1 and No. 2 TEMP jacks but thermistor method respiration can be measured at the No. 1 and No. 2 multi-parameter sockets. | Replace the board with a new one. |
| | The first MP1 board has a failure if the temperature cannot be measured at the No. 1 and No. 2 TEMP jacks, and thermistor method respiration cannot be measured at the No. 1 and No. 2 multi-parameter sockets. | |
| | The second MP2 board has a failure if the T1 and T2 temperatures cannot be measured at the No. 5 multi-parameter socket but the thermistor method respiration and FiO2 can be measured at the No.3, No.4 and No.5 multi-parameter sockets. | |
| | The second MP1 board or MP3 board has a failure if the T1 and T2 temperatures and thermistor method respiration cannot be measured at the No. 5 multi-parameter socket. | |
| Temperature measurement data on the screen is wrong. | The thermistor probe has a failure. | Replace the probe with a new one. |
| | The first MP2 board or TEMP board has a failure if the temperature values are wrong at the No. 1 and No. 2 TEMP jacks but thermistor method respiration rate is acceptable at the No. 1 and No. 2 multi-parameter sockets. | Replace the faulty board with a new one. |
| | The second MP2 board has a failure if the T1 and T2 temperature values are wrong at the No. 5 multi-parameter socket but the thermistor method respiration rate and FiO2 value are acceptable at the same socket. | |
| Respiration by thermistor method cannot be measured. | The respiration pickup (thermistor probe) has a failure. | Replace the pickup with a new one. |
| | The first MP1 board or first MP2 board has a failure if the thermistor method respiration cannot be measured at the No. 1 and/or No. 2 multi-parameter sockets. | Replace the board with a new one. |
| | The first MP1 board or first MP2 board has a failure if the thermistor method respiration cannot be measured at the No. 1 or No. 2 multi-parameter socket. | |
| | The second MP1 board or second MP2 board has a failure if the CO (Tb) can be measured but the thermistor method respiration cannot be measured at the No. 3, No. 4 and No. 5 multi-parameter sockets, or the thermistor method respiration can be measured at one of the three sockets. | |
| | The second MP1 board has a failure if the T1 and T2 temperatures and thermistor method respiration can be measured at the No. 5 multi-parameter socket but cannot be measured at the No. 3 and No. 4 multi-parameter sockets. | |
| | The MP3 board, second MP1 board or Mother CN board has a failure if the thermistor method respiration cannot be measured at the No. 5 multi-parameter socket only. | |
| | The second MP1 board has a failure if the thermistor method respiration cannot be measured at the No. 3 and/or No. 4 multi-parameter socket(s). | |
| Thermistor method respiration waveform has something wrong on the screen. | The respiration pickup (thermistor probe) has a failure. | Replace the pickup with a new one. |
| | The first MP1 board or first MP2 board has a failure if the CO (Tb) values are acceptable but the thermistor method respiration rate is wrong at the No. 1 and No. 2 multi-parameter sockets. | Replace the board with a new one. |
| | The second MP1 board or second MP2 board has a failure if the CO (Tb) values are acceptable but the thermistor method respiration rate is wrong at the No. 3, No. 4 and No. 5 multi-parameter sockets. | |

| Problem | Possible Cause/Criteria | Action |
|---|---|---|
| FiO2 cannot be measured. | The FiO2 sensor or connection cord has a failure. | Replace the $FiO_2$ sensor or connection cord with a new one. |
| | The first MP2 board has a failure if the FiO2 cannot be measured but the CO (Ti) can be measured at the No. 1 and No. 2 multi-parameter sockets. | Replace the board with a new one. |
| | The first MP1 board or first MP2 board has a failure if the FiO2 cannot be measured at the No. 1 and No. 2 multi-parameter sockets. | |
| | The second MP2 board has a failure if the FiO2 cannot be measured at the No. 3, No. 4 and No. 5 multi-parameter sockets but the CO (Ti) can be measured at the same multi-parameter sockets, or the FiO2 can be measured at one of these multi-parameter sockets. | |
| | The MP3 board, second MP2 board or Mother CN board has a failure if the FiO2 cannot be measured at the No. 5 multi-parameter socket only. | |
| | The second MP1 or second MP2 board has a failure if the FiO2 cannot be measured at the No. 3 or No. 4 multi-parameter socket. | |
| FiO2 data on the screen is wrong. | The FiO2 sensor has a failure. | Replace the FiO2 sensor with a new one. |
| | The first MP2 board has a failure if the FiO2 value is wrong but the CO (Ti) values are acceptable at the No. 1 and No. 2 multi-parameter sockets. | Replace the board with a new one. |
| | The second MP2 board has a failure if the FiO2 value is wrong but the CO (Ti) values are acceptable at the No. 3, No. 4 and No. 5 multi-parameter sockets. | |
| CO2 cannot be measured. | The CO2 sensor or CO2 adapter has a failure. | Replace the CO2 sensor or adapter with a new one. |
| | The first MP2 board has a failure if the CO2 cannot be measured at the No. 1 and No. 2 multi-parameter sockets. | Replace the board with a new one. |
| | The first MP1 board or first MP2 board has a failure if the CO2 cannot be measured at the No. 1 or No. 2 multi-parameter socket. | |
| | The second MP2 board has a failure if the CO2 cannot be measured at the No. 3, No. 4 and No. 5 multi-parameter sockets. | |
| | The MP3 board, second MP2 or Mother CN board has a failure if the CO2 cannot be measured at the No. 5 multi-parameter socket | |
| | The second MP1 board or second MP2 board has a failure if the CO2 cannot be measured at the No. 3 or No. 4 multi-parameter socket | |
| CO2 data on the screen is wrong. | The CO2 sensor has a failure. | Replace the sensor with a new one. |
| | The CO2 adapter has a failure. | Replace the adapter with a new one. |

| Problem | Possible Cause/Criteria | Action |
|---|---|---|
| CO cannot be measured. (Injectant temperature Ti or blood temperature Tb cannot be measured or CO curve does not appear.) | The catheter, bath probe, inline sensor or connection cord has a failure. | Replace the catheter, bath probe, inline sensor or connection cord with a new one. |
| | The first MP2 board has a failure if the Ti or Tb cannot be measured at the No. 1 or No. 2 multi-parameter sockets or the CO curve does not appear at the same multi-parameter sockets. | Replace the board with a new one. |
| | The first MP1 board or first MP2 board has a failure if the Ti or Tb cannot be measured at the No. 1 or No. 2 multi-parameter sockets or the CO curve does not appear at the same multi-parameter sockets. | |
| | The second MP2 board has a failure if the Ti or Tb cannot be measured at the No. 3, No. 4 or No. 5 multi-parameter sockets or the CO curve does not appear at the same multi-parameter sockets. | |
| | The MP3 board, second MP2 board or Mother CN board has a failure if the Ti or Tb cannot be measured at the No. 5 multi-parameter socket or the CO curve does not appear at the same multi-parameter socket. | |
| | The second MP1 board or second MP2 board has a failure if the Ti or Tb cannot be measured at the No. 3 or No. 4 multi-parameter socket(s) or the CO curve does not appear at the same multi-parameter socket(s). | |
| CO data on the screen is wrong. (Ti or Tb temperature data on the screen is wrong.) | The catheter, bath probe or inline sensor has a failure. | Replace the catheter, bath probe or inline sensor with a new one. |
| | The first MP2 board has a failure if the Ti data is wrong but the FiO2 data is acceptable at the No. 1 and No. 2 multi-parameter sockets or Tb data is wrong but the thermistor method respiration rate is acceptable at the same multi-parameter sockets. | Replace the board with a new one. |
| | The second MP2 board has a failure if the Ti data is wrong but the FiO2 data is acceptable at the No. 3, No. 4 and No. 5 multi-parameter sockets or Tb data is wrong but the thermistor method respiration rate is acceptable at the same multi-parameter sockets. | |
| The gas concentration data is wrong. | The gain setting is wrong. | Perform the gas calibration according to the operator's manual. |
| | The gas sensing unit has a failure. | Replace the gas sensing unit with a new one. |
| "UNIT FAILURE" message is displayed on the screen. | The gas sensing unit has a failure. | Replace the gas sensing unit with a new one. |
| "LINE BLOCK" or "CHECK SAMPLE LINE" message is displayed on the screen. | The internal tube has a clog. | Remove the clog from the tube. |
| | The gas sensing unit has a failure. | Replace the gas sensing unit with a new one. |
| "CHECK WATERTRAP" message is displayed on the screen. | The Dryline receptacle is not correctly attached to the front cover. | Correctly attach the Dryline receptacle to the front cover. |
| | The Dryline receptacle has a failure. | Replace the Dryline receptacle with a new one. |

# ECG/BP Output Problems

| Problem | Possible Cause/Criteria | Action |
|---|---|---|
| The instrument does not output the ECG, HT (heart rate) or BP signal from the ECG/BP OUT socket. | The ECG/BP output cable is faulty. | Replace the ECG/BP output cable with a new one. |
| | The ECG and HT signals do not output without ECG measurement. | Measure the ECG. |
| | The BP signal is not output if the blood pressure is measured at the No. 2 or No. 3 multi-parameter sockets. | Measure the invasive blood pressure at the No. 1 multi-parameter socket. |
| | The connection cable between the DPU SP board and ECG RESP1 board is disconnected if the ECG, HT and BP are not output. | Check the connection. |
| | The DPU SP board or ECG RESP1 board is faulty if one of the three signals (ECG, HT and BP) is not output. | Replace the DPU SP board or ECG input block with a new one*. |
| The ECG or BP waveform from the ECG/BP OUT socket is wrong. | The DPU SP board is faulty if the ECG or BP waveform amplitude is wrong at the ECG/BP OUT socket but the ECG and invasive blood pressure waveforms are correctly displayed on the screen. | Replace the faulty board with a new one. |

* ECG input block repair kit is required when one of the ECG RESP1, ECG RESP2, ECG RESP3 and mother PWR boards has a failure. Refer to "Board Compatibility" in Section10 "Internal Switch Setting and Board Compatibility".

# Option Problems

| Problem | Possible Cause/Criteria | | Action |
|---|---|---|---|
| The instrument does not transmit the patient's data at all. | The optional ZS-900P transmitter is not connected to the instrument. | | Connect the ZS-900P to the instrument completely. |
| | The channel for the ZS-900P is not set at the central monitor or telemetry system. | | Set the channel correctly at the central monitor or telemetry system. |
| | The ZS-900P or DPU SP board is faulty. | | Replace the faulty transmitter or DPU SP board with a new one. |
| The instrument has no communication with the other bedside monitors and central monitors. | The optional QI-101P network card is not installed into the instrument. | | Install the network card into the instrument completely. |
| | The network communicating symbol does not appear on the screen. | The network card is poorly inserted into the slot of the instrument. | Firmly insert the network card into the slot. |
| | | The network cable such as 10Base-T cable is poorly connected between the network card and hub. | Firmly connect the network cable between the network card and hub. |
| | | The hub connected to the instrument is not turned on or is faulty. | Turn on the hub. Replace the hub with a new one if the problem still exists after the power is turned on. |
| | | The instrument is connected to the hub with 10Base-T cross wiring cable. | Use the correct internal wiring 10Base-T cable. |
| | | The instrument is directly connected to the central monitor with 10Base-T straight wiring cable. | |
| | | The network cable is faulty. | Replace the network cable with a new one. |
| | | The network card or MAIN board is faulty. | Replace the faulty network card or MAIN board with a new one. |

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# *Section 3 Diagnostic Check*


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# Introduction

The instrument has two check programs which automatically or manually diagnose the instrument. The automatic check program (power on self check) is executed whenever the instrument is turned on. The manual check program can be executed at any time.

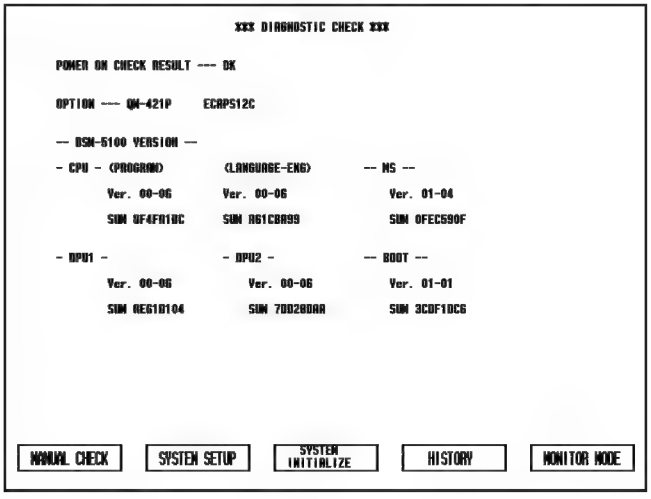
All errors detected during the power on self check, manual check, and any time in monitor mode are stored in an error history table that you can view.

The manual check, error history, and system setup and initialization are accessed from the DIAGNOSTIC CHECK screen.

# Power On Self Check

The following icon appears during the power on self check.

If no error is detected, the monitor mode begins and the patient monitoring display appears. If a serious error which does not allow the host CPU to execute the system program any more is detected, the screen changes to the following DIAGNOSTIC CHECK screen and the error mesage is displayed.


*** DIAGNOSTIC CHECK ***
POWER ON CHECK RESULT --- OK
OPTION --- QM-421P ECAPS12C
-- BSM-5100 VERSION --
- CPU - (PROGRAM) (LANGUAGE-ENG) -- MS --
Ver. 00-06 Ver. 00-06 Ver. 01-04
SUM 0F4FB10C SUM A61CBA99 SUM 0FEC590F
- DPU1 - - DPU2 - -- BOOT --
Ver. 00-06 Ver. 00-06 Ver. 01-01
SUM 0EE1B104 SUM 70D20DAA SUM 3CDF1DC6
MANUAL CHECK
SYSTEM SETUP
SYSTEM INITIALIZE
HISTORY
MONITOR MODE

If a minor error such as “Backup data is damaged” or “Super capacitor is discharged” is detected, the monitor mode begins and the patient monitoring display appears after the power on self check. The detected error is stored in the error history table. Refer to “Calling Up the Error History” section.

The MAIN board and DPU board are checked as follows:

- CPU ROM CHECK: Checks the system ROM for the host CPU on the MAIN board. The MAIN board will be faulty if an error which causes a partial screen problem is found.
- CPU RAM CHECK: Checks the system RAM for the host CPU and patient data storage. The MAIN board will be faulty if an error which causes a screen problem is found.
- DPU ROM CHECK: Checks the system ROM for the CPU on the DPU board. The DPU board will be faulty if an error which causes a screen problem or data/ waveform display problem is found.
- DPU RAM CHECK: Checks the system RAM for the CPU on the DPU board. The DPU board will be faulty if an error which causes a screen problem or data/ waveform display problem is found.
- 2PORT RAM CHECK: Checks the common memory (Dual port RAM on the DPU board) for the communication between the MAIN and DPU boards. The DPU board will be faulty if an error which causes a screen problem or data/ waveform display problem is found.
- CLOCK IC CHECK: Checks the real-time clock IC on the MAIN board. If the date or time is wrong, the clock IC is initialized. The MAIN board will be faulty if an error is found.
- A/D CHECK: Checks the system counter. The MAIN board will be faulty if an error which disables the data processing function is found.
- E2PROM CHECK: Checks the backup memory for the system setup data storage. If the data is wrong, the memory is initialized. The MAIN board will be faulty if an error is found.

If a serious error is found in the abovementioned checks, the instrument displays the DIAGNOSTIC CHECK screen without displaying the patient monitoring screen.

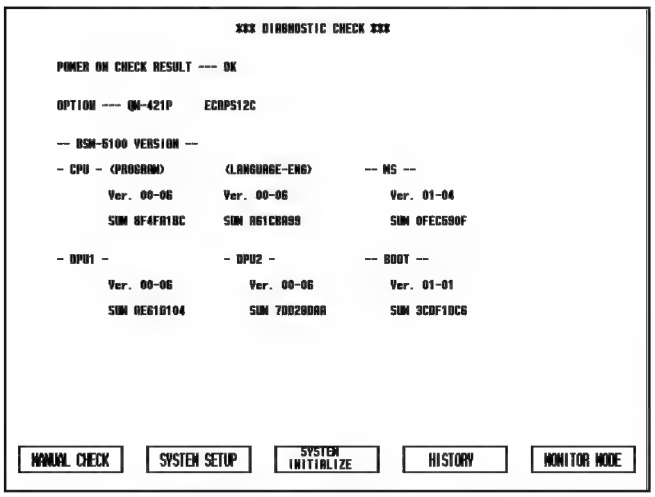
The following data checks are also done. The data is corrected if necessary.

- BACK UP CHECK: Checks the backed up data. If the backed up data has something wrong, the data is initialized.
- TIME CHECK: Checks correctness of the time.
- GET TIME CHECK: Checks the period during the AC power off in the battery operation and adjusts the time data if it is wrong.

# Calling Up the DIAGNOSTIC CHECK Screen

Use this screen to view the error history or perform manual check or system setup and initialization.

1. With the power off, press the Power switch while pressing the SILENCE ALARMS key. Continue pressing the SILENCE ALARMS key until the DIAGNOSTIC CHECK screen appears.

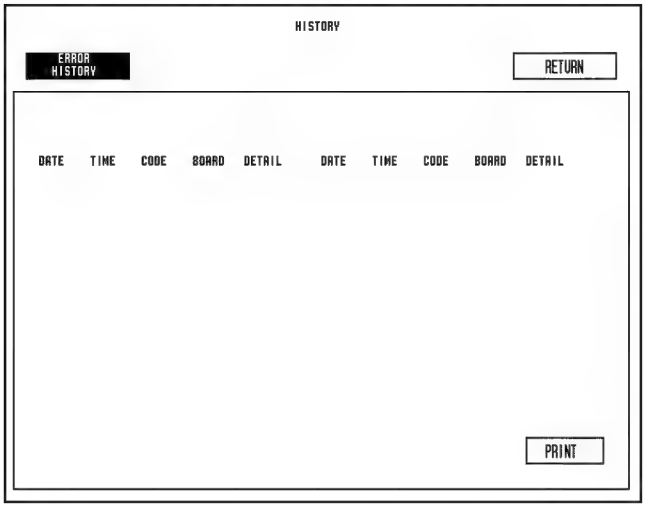

*** DIAGNOSTIC CHECK ***
POWER ON CHECK RESULT --- OK
OPTION --- CM-421P ECRP512C
-- BSM-5100 VERSION --
- CPU - (PROGRAM) (LANGUAGE-ENG) -- MS --
Ver. 00-06 Ver. 00-06 Ver. 01-04
SUM 8F4FA18C SUM A61CBA99 SUM 0FEC690F
- DPU1 - - DPU2 - -- BOOT --
Ver. 00-06 Ver. 00-06 Ver. 01-01
SUM AE61B104 SUM 7DB28DAA SUM 3CDF10C6
MANUAL CHECK
SYSTEM SETUP
SYSTEM INITIALIZE
HISTORY
MONITOR MODE

2. To exit the DIAGNOSTIC CHECK screen and return to the patient monitoring mode, touch the “MONITOR MODE” key.

# Calling Up the Error History

The ERROR HISTORY screen shows the error history of the instrument. The error code, board name, time, and date the error occurred are listed on this screen. For an explanation of error codes, see the "Error Codes" section. The error history data is deleted whenever system initialization is performed.

1. From the DIAGNOSTIC CHECK screen, touch the "HISTORY" key. The HISTORY screen appears. Then, touch the "ERROR HISTORY" key to display the error history.




2. Touch the "PRINT" key to print the screen with the recorder.

3. To return to the MANUAL CHECK MENU screen, touch the "RETURN" key.

## Error Codes

When a fault is detected during operation or during the power on self check, the error is stored in the error history table. The error codes stored in the error history are only deleted when system initialization is performed. If the memory space for the error history is filled up, however, the oldest error code is deleted when a new error code is added.

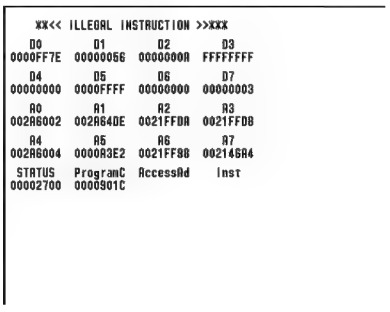
The message and description of each error code are described in the following table:

| Error Code | Message | Description |
|---|---|---|
| 0110 | WATCH DOG | Interrupt from the watch dog timer |
| 0210 | BUS | Bus error occurred when an empty address was selected |
| 0220 | ADDRESS | Address error when a word accessed the odd address |
| 0230 | ILLEGAL | Illegal command is executed |

| | | |
|---|---|---|
| 0240 | ZERO | Zero division error |
| 0250 | CHK | Check command error occurred during check |
| 0260 | TRAP | Trap command error |
| 0270 | PRIVILEGE | Privilege error |
| 0280 | SPURIOUS | Undefined interrupt error |
| 0290 | UNDEFINED | Not used |
| 02A0 | UNDEFINED | Not used |
| 02B0 | UNDEFINED | Not used |
| 02C0 | OTHER | Error from faults other than ones described above |
| 0310 | OS | Error detected by the OS |
| 0410 | CPU (ROM) | Error detected by CPU ROM check |
| 0411 | WS (ROM) | Error detected by WS ROM check |
| 0420 | CPU (RAM) | Error detected by CPU RAM check |
| 0430 | CPU (CMRAM) | Error detected by CPU communication RAM check |
| 0440 | A/D, D/A | Error detected by A/D and D/A check |
| 0470 | CLOCK | Error detected by the real time clock |
| 0472 | CLK DATA | Error detected by CLOCK DATA check |
| 0480 | E2PROM | Error detected by EEPROM check |
| 0510 | ATA CARD ACCESS ERROR | Error detected by ATA card (QM-421P) check |
| 0400 | OTHER | Error from faults other than those described above |
| A410 | DPU (ROM) | Error detected by DPU ROM check |
| A420 | DPU (RAM) | Error detected by DPU RAM check |
| A430 | DPU (CMRAM) | Error detected by DPU communication RAM check |

## System Errors

A system error occurs when a fatal fault is detected during operation. All operation of the instrument is halted and the CPU operation status data at the system error appear on the left top of the screen. The system error is mostly stored in the error history table. In a few seconds after the status data is displayed, the instrument restarts. If the instrument repeats the restart, the MAIN board will be faulty.

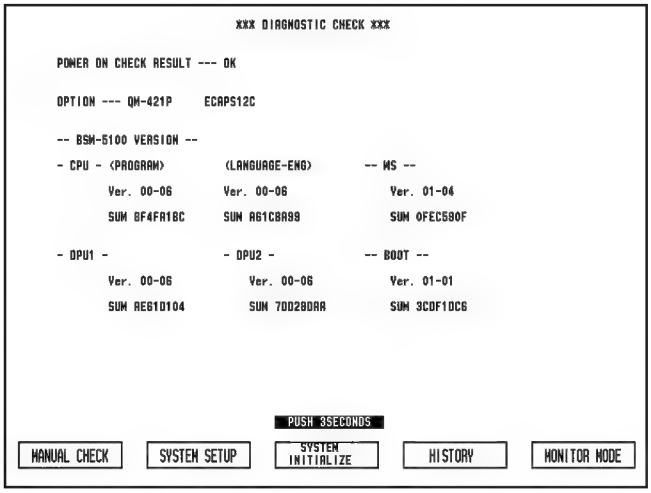


# Initializing the System

You can delete all stored waveforms and data and the error history and return all settings to the factory defaults.

**CAUTION**

**Initializing the system deletes all the patient data and error history, and returns the setting conditions to their default settings.**

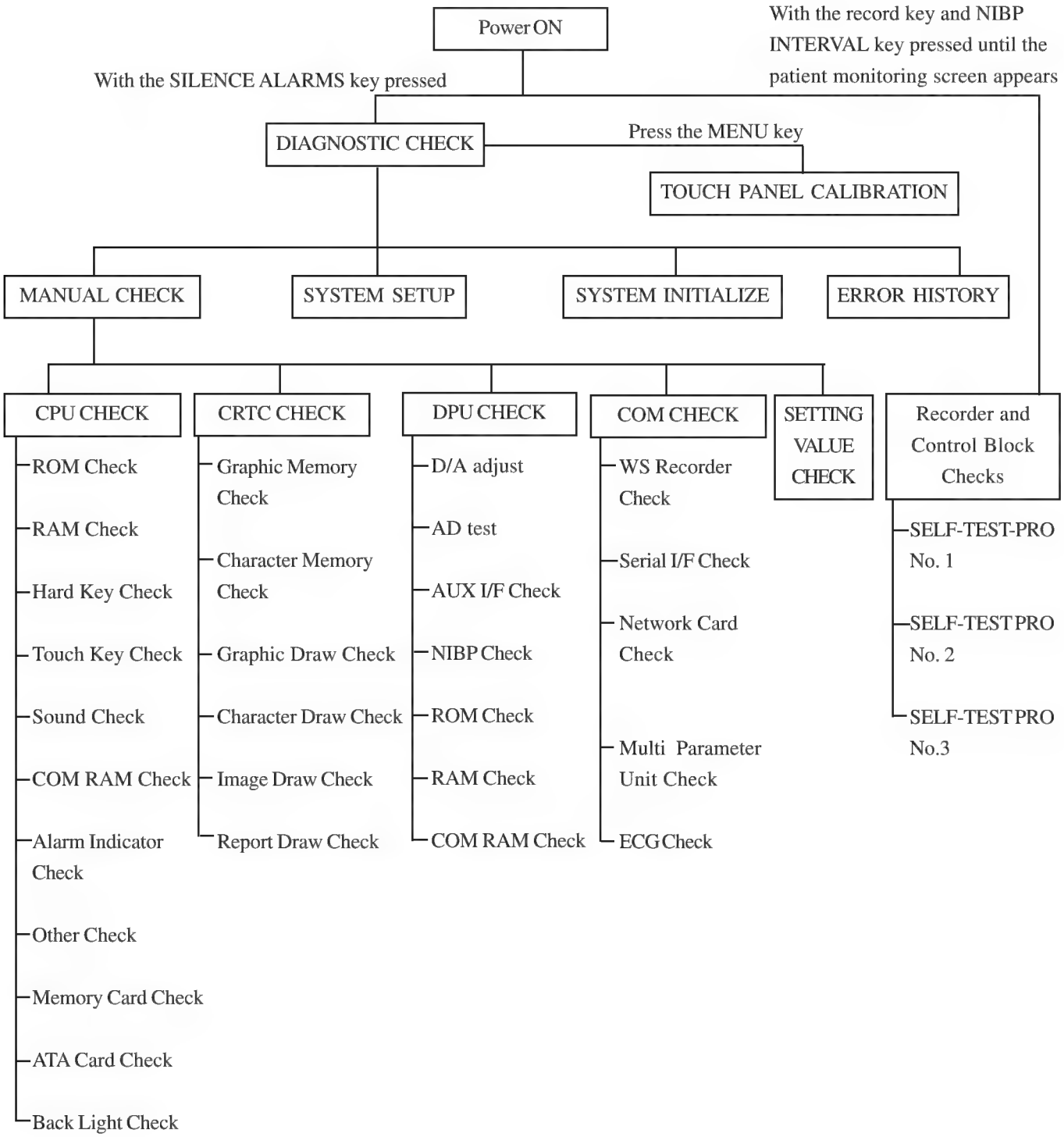

xxx DIAGNOSTIC CHECK xxx
POWER ON CHECK RESULT --- OK
OPTION --- QM-421P ECAPS12C
-- BSM-5100 VERSION --
- CPU - <PROGRAM> (LANGUAGE-ENG) -- MS --
Ver. 00-06 Ver. 00-06 Ver. 01-04
SUM BF4FA18C SUM A81C8A99 SUM 0FEC590F
- DPU1 - - DPU2 - -- BOOT --
Ver. 00-06 Ver. 00-06 Ver. 01-01
SUM AE810104 SUM 70D280AA SUM 3CDF1DC6
PUSH 3SECONDS
MANUAL CHECK
SYSTEM SETUP
SYSTEM INITIALIZE
HISTORY
MONITOR MODE

1. From the DIAGNOSTIC CHECK screen, touch the "SYSTEM INITIALIZE" key until a SYSTEM INITIALIZE confirmation message appears. (Approximately 3 seconds)
   All data and user settings are deleted.

2. To exit the DIAGNOSTIC CHECK screen and return to the patient monitoring mode, touch the "MONITOR MODE" key.

# Performing Manual Check and Other Checks

The following checks are available.




In most of these checks, if a fatal error is detected during the check, the operating system hangs. When the system hangs, turn off the instrument and remove the cause.

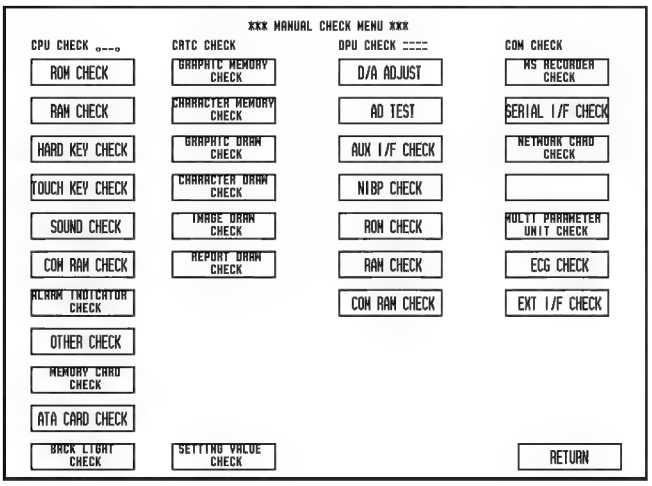
## Calling Up the MANUAL CHECK MENU Screen

1. From the DIAGNOSTIC CHECK screen, touch the "MANUAL CHECK" key. The MANUAL CHECK MENU screen appears.

2. To test each item from the MANUAL CHECK MENU screen, touch a menu item key.

3. To return to the DIAGNOSTIC CHECK screen, touch the "RETURN" key.

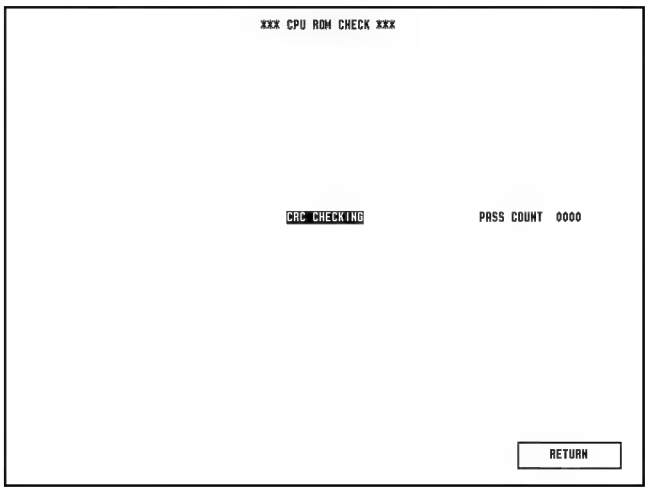
4. To exit the DIAGNOSTIC CHECK screen and return to the patient monitoring mode, touch the "MONITOR MODE" key.



## CPU Check Menu Items

The CPU check menu items check the function of the CPU peripherals such as ROMs, RAMs, Switches, Touch Key, Sound generators, Alarm indicators and external memory modules.

### ROM Check




This item checks the ROMs on the MAIN and DPU boards by the CRC (cyclic redundancy check) technique. This check assigns a count number when one set of checks is successfully completed. A set of checks takes about 1 minute and 30 seconds.

If an error message appears, the MAIN board or DPU board will be faulty.

***Procedure to Start and Exit the ROM Check Program***

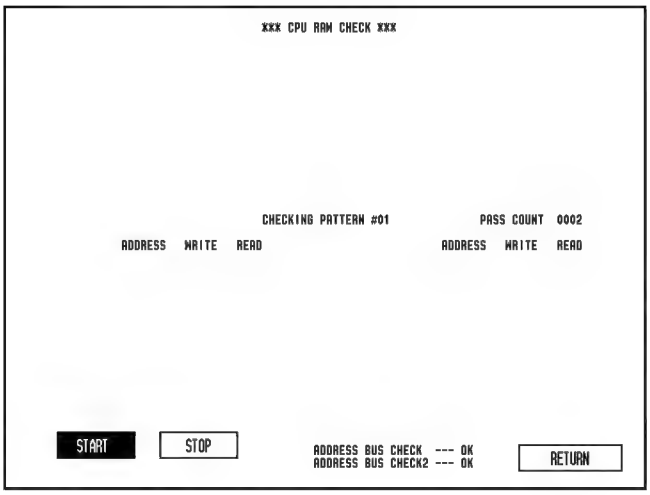
1. To select the ROM Check, touch the "ROM CHECK" key. The instrument automatically starts the ROM check.

2. The instrument repeats the check and increments the pass count until you touch the "RETURN" key.

3. If the check program finds an error, it displays the type of ROM (PROGRAM or IMAGE) in the above area.

4. To return to the MANUAL CHECK MENU screen at any time, touch the "RETURN" key.

### RAM Check




This item checks the RAM on the MAIN and DPU boards by comparing the test patterns it first wrote to the RAM with the test patterns it later read from the RAM. This test uses 15 test patterns and assigns a count number when a comparison of the 15 test patterns is successfully completed. The comparison of all the test patterns in this check takes about 4 minutes.

This check deletes the patient data. If an error message appears, the MAIN board or DPU board will be faulty.

***Procedure to Start, Stop, and Exit the RAM Check Program***

1. To select the RAM Check, touch the "RAM CHECK" key. The instrument automatically starts the RAM check.

2. The instrument repeats the check and increments the pass count until the operator touches the "RETURN" key.

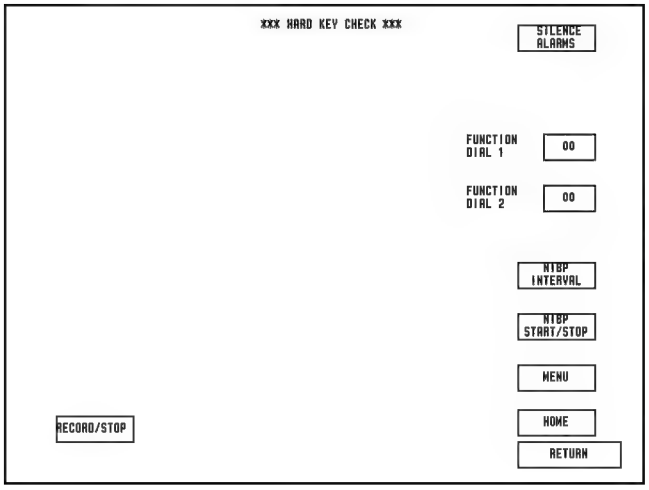
3. If the check program finds an error, it displays the address, write data and read data as shown in the above table.

4. To stop the check temporarily, touch the "STOP" key. The "START" key name changes to normal and the "STOP" key is highlighted.

   To continue the check, touch the "START" key again.

5. To return to the MANUAL CHECK MENU screen at any time, touch the "RETURN" key.

### Hard Key Check




This item checks the operation of the hard keys on the front panel and the function dials. The hard key and dial layout appear. Pressing the hard key or rotating the function dial usually highlights the corresponding hard key or dial on the screen.

If the pressed hard key is not highlighted, the hard key may be faulty. If more than one hard key has this symptom, the operation board, function dial board or MAIN board will be faulty.

**NOTE**

**The key does not give a key click sound when it is pressed in this check.**

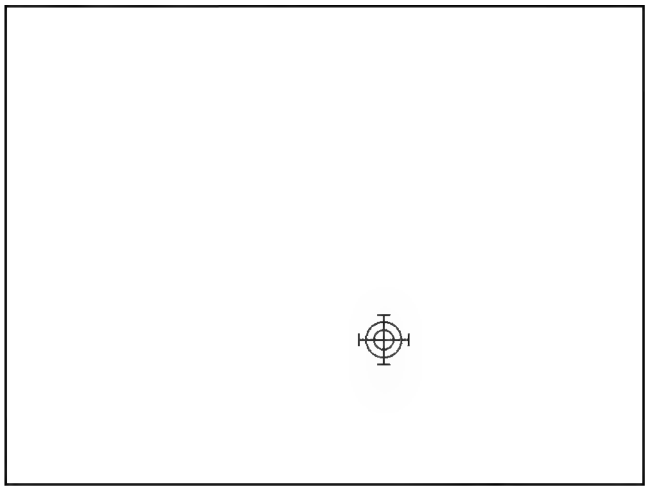
***Procedure to Start the Check Keys or to Exit the Key Check Program***

1. To check the hard keys, touch the "HARD KEY CHECK" key.

2. In the above screen, confirm that the corresponding pressed key is highlighted on the screen.

3. To return to the MANUAL CHECK MENU screen, touch the "RETURN" key.

### Touch Key Check



This item checks the touch key operation and positioning. When you start the check, the screen changes to the touch key check screen, and indicates the position where you touched. When you touch the screen and move your finger or touch pen, the target mark traces your position.

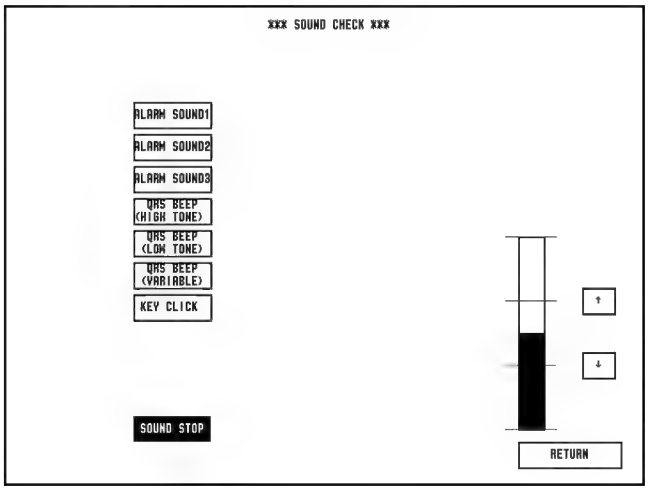
If the position of the target mark and the touched position do not match, calibrate the touch screen.

If you execute the touch key calibration and the position is still incorrect, the connection board, touch screen, or MAIN board will be faulty.

***Procedure to Start the Touch Key Check or to Exit the Touch Key Check Program***

1. To check the touch key, touch the "TOUCH KEY CHECK" key.
2. On the above screen, confirm that the touched position matches the target mark on the screen.
3. To return to the DIAGNOSTIC CHECK screen, press the HOME key.

## Sound Check




This item checks the 7 types of sounds generated by the instrument. This check can also be used to check the alarm circuit and the QRS beep circuit. Check the quality of sound, loudness, noise, incorrect sound, etc.

If there is no sound or distorted sound, the speaker or MAIN board will be faulty.

***Procedure to Check the Sound***

1. To check the sound, touch the "SOUND CHECK" key.

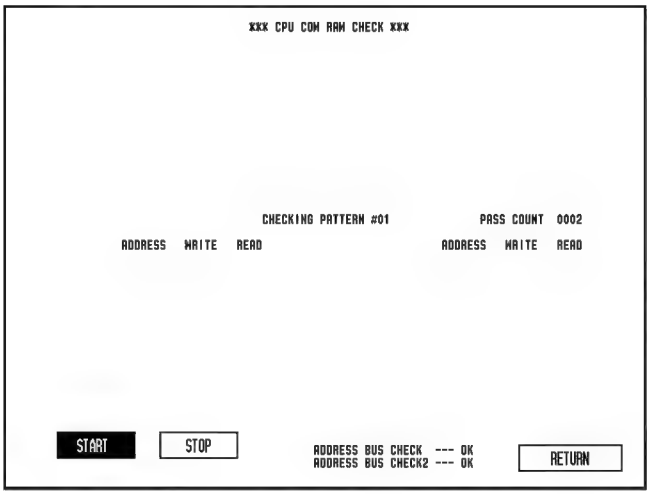
2. Touch a sound key, such as "ALARM SOUND1", "ALARM SOUND2", "ALARM SOUND3", "QRS BEEP (HIGH TONE)", "QRS BEEP (LOW TONE)", "QRS BEEP (VARIABLE)", "KEY CLICK" to start the check for that sound.

3. To stop the check, touch the "SOUND STOP" key.

4. To change the sound volume, touch the "↑" or "↓" key.

5. To return to the MANUAL CHECK MENU screen, touch the "RETURN" key.

### COM RAM Check




This item checks the dual port RAM for communication between the host CPU on the MAIN board and CPU on the DPU board. The check method is the same as the system RAM check. The check program indicates the address, write data and read data if an error is detected.

This RAM is located on the DPU board. Therefore if an error is detected, the DPU board or connector which connects the MAIN and DPU boards will be faulty.

***Procedure to Start, Stop, and Exit the COM RAM Check Program***

1. To select the COM RAM Check, touch the "COM RAM CHECK" key. The instrument automatically starts the RAM check.

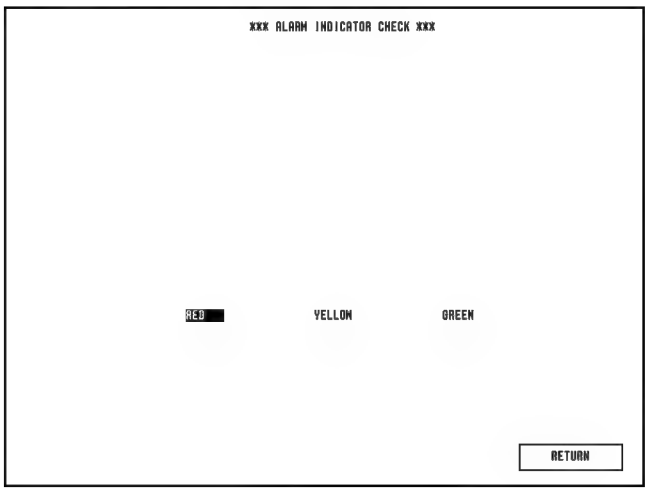
2. If the check program finds an error, it displays the address, write data and read data as shown in the above table.

3. To stop the check temporarily, touch the "STOP" key. The "START" key name changes to normal and the "STOP" key is highlighted.

   To continue the check, touch the "START" key again.

4. To return to the MANUAL CHECK MENU screen, touch the "RETURN" key.

## ALARM INDICATOR Check




This item checks the function of the alarm indicator located on the top of the instrument. Check the light of indicator lamp according to the screen indication.

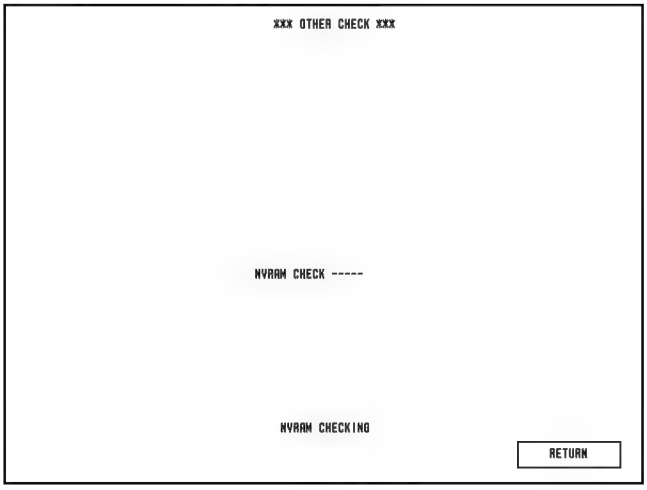
If the color does not light, the connection cable is loose or disconnected or the MAIN board or indicator board will be faulty. If the indicator lights partially, the indicator board is faulty.

***Procedure to Start the ALARM INDICATOR Check Program***

1. To select the Alarm Indicator Check, touch the "ALARM INDICATOR CHECK" key. The lighting color is highlighted on the screen sequentially.

2. To return to the MANUAL CHECK MENU screen, touch the "RETURN" key.

### OTHER Check




This item checks the clock IC and backup NVRAM (EEPROM). The NVRAM contains the system setup data. The check program checks correspondence between write and read data with the stored data retention. Therefore, this check does not damage the system setup data. If the clock IC and NVRAM have no error, the "OK" message appears on the screen and current date and time appear at the top of the screen. If an error message appears, the MAIN board will be faulty.

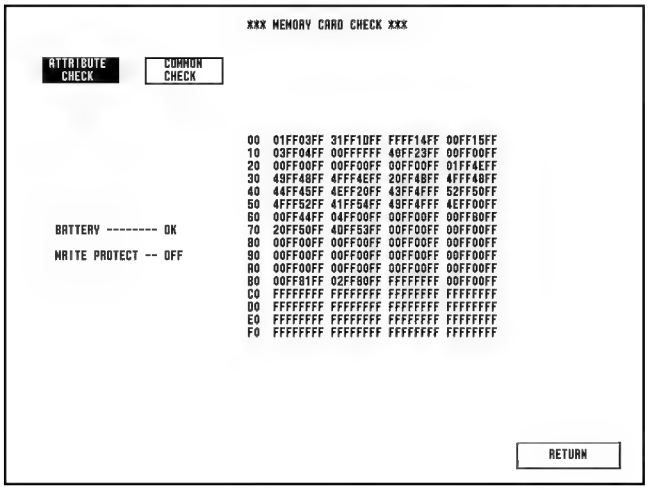
***Procedure to Execute the OTHER Check Program***

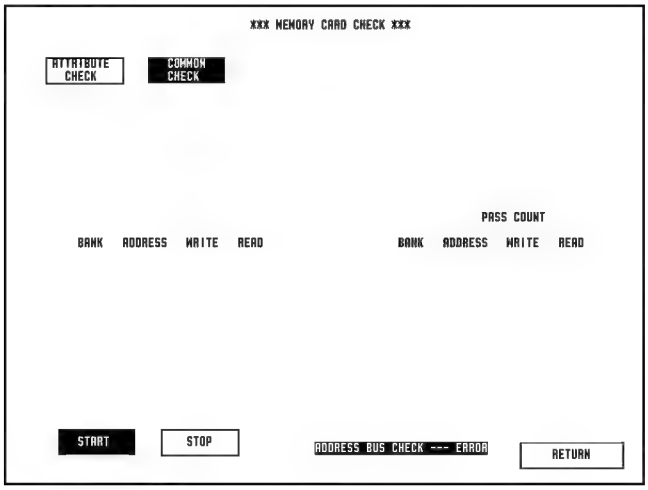
1. To select the OTHER Check, touch the "OTHER CHECK" key.

   The program starts the checking automatically and several minutes later, the program displays the result of checking.

2. To return to the MANUAL CHECK MENU screen, touch the "RETURN" key.

## MEMORY CARD Check


*** MEMORY CARD CHECK ***
ATTRIBUTE CHECK
COMMON CHECK
00 01FF03FF 31FF1DFF FFFF14FF 00FF15FF
10 03FF04FF 00FFFFFF 49FF23FF 00FF00FF
20 00FF00FF 00FF00FF 00FF00FF 01FF4EFF
30 49FF48FF 4FFF4EFF 20FF4BFF 4FFF4BFF
40 44FF45FF 4EFF20FF 43FF4FFF 52FF50FF
50 4FFF52FF 41FF54FF 49FF4FFF 4EFF00FF
60 00FF44FF 04FF00FF 00FF00FF 00FF80FF
70 20FF50FF 4DFF53FF 00FF00FF 00FF00FF
80 00FF00FF 00FF00FF 00FF00FF 00FF00FF
90 00FF00FF 00FF00FF 00FF00FF 00FF00FF
A0 00FF00FF 00FF00FF 00FF00FF 00FF00FF
B0 00FF81FF 02FF80FF FFFFFFFF 00FF00FF
C0 FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF
D0 FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF
E0 FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF
F0 FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF
BATTERY -------- OK
WRITE PROTECT -- OFF
RETURN




This item checks the inserted PCMCIA card and its interface. There are two checks. The ATTRIBUTE CHECK displays the dump list of attribute area which is in the PCMCIA card. The COMMON CHECK is the write/read check for common area. This check continues until you touch the "STOP" key or "RETURN" key. The check method is the same as the system RAM check.

If the PCMCIA card is not inserted, the program displays the CARD NOT INSERTED message on the screen.

If an error is detected, the PCMCIA card or MAIN board will be faulty.

***Procedure to Start MEMORY CARD Check Program***

1. To select the MEMORY CARD Check, touch the "MEMORY CARD CHECK" key.

2. To display the dump list of attribute area which is in the memory card, touch the "ATTRIBUTE CHECK" key.

3. To start the common check, touch the "COMMON CHECK" key.

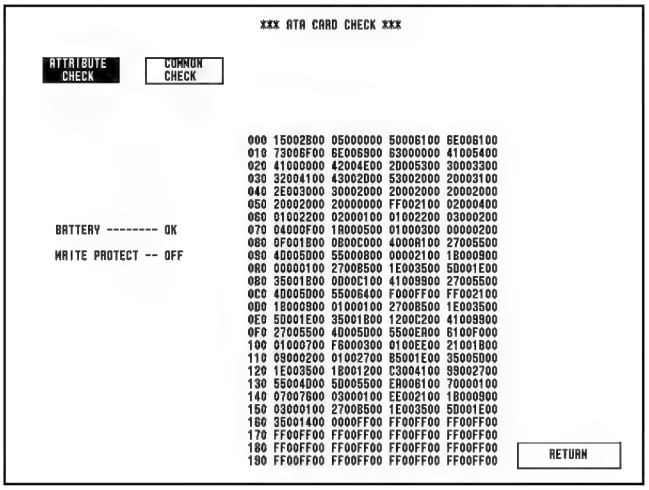
   If the check program finds an error, it displays the address, write data and read data as shown in the above table.

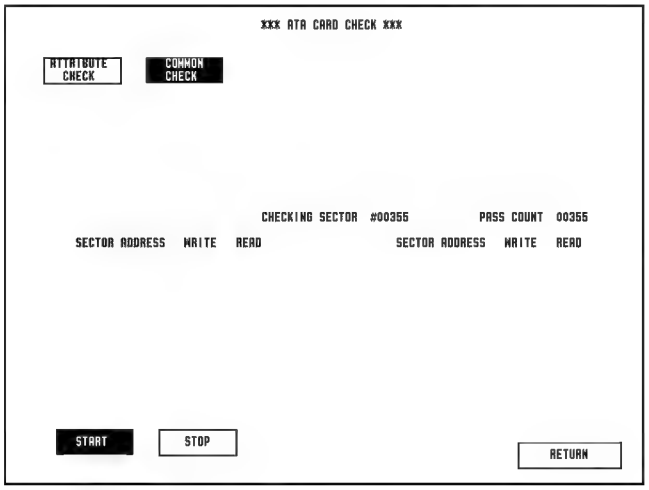
4. To stop the check temporarily, touch the "STOP" key. The "START" key name changes to normal and the "STOP" key is highlighted.

   To continue the check, touch the "START" key again.

5. To return to the MANAUL CHECK MENU screen, touch the "RETURN" key.

## ATA CARD Check




This item checks the ATA card and its interface. This check is almost the same as the MEMORY CARD check, except for the COMMON CHECK.

The COMMON CHECK is the write/read check for common area by each sector. This check continues until you touch the "STOP" key or "RETURN" key.

The check method is the same as the system RAM check.

If an error is detected, the ATA card or MAIN board will be faulty.

***Procedure to Start and Exit the ATA CARD Check Program***

1. To select the ATA CARD Check, touch the "ATA CARD CHECK" key.

2. To display the dump list of attribute area which is in the ATA CARD, touch the "ATTRIBUTE CHECK" key and touch the "NEXT PAGE" or "PREVIOUS PAGE" keys, if necessary.

3. To start the common check, touch the "COMMON CHECK" key.

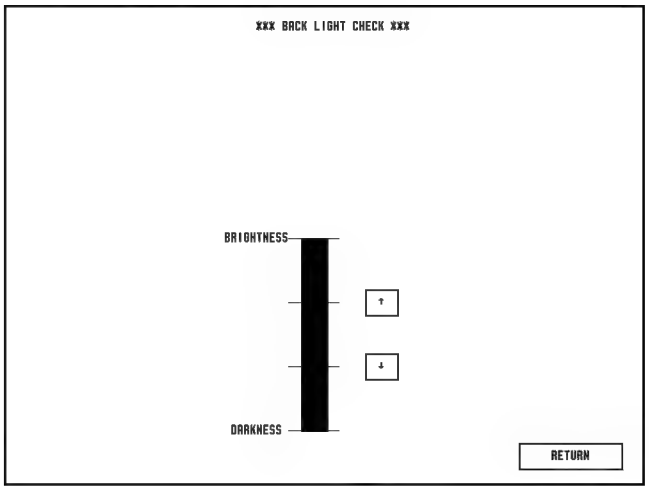
   If the check program finds an error, it displays the address, write data and read data as shown in the above table.

4. To stop the check temporarily, touch the "STOP" key. The "START" key name changes to normal and the "STOP" key is highlighted.

   To continue the check, touch the "START" key again.

5. To return to the MANUAL CHECK MENU screen, touch the "RETURN" key.

### Backlight Check




This item checks the brightness control of the LCD backlight. While the brightness is manually changed, check that it changes smoothly with no twinkling. Check that the backlight goes off and has no twinkling when the brightness is set to minimum.

If the brightness does not change smoothly or the light goes off in the middle of the brightness bar on the screen, it indicates the end of life of the backlight or faulty inverter board.

In that case, replace the inverter board, or fluorescent tube which is located on the top of the backlight unit.

***Procedure to Check the Brightness of the LCD Backlight***

1. To select the Backlight Check, touch the "BACK LIGHT CHECK" key.

   To control the brightness, touch the bargraph or the "↑" or "↓" key to increase or decrease the brightness.

2. To return to the MANUAL CHECK MENU screen at any time, touch the "RETURN" key.

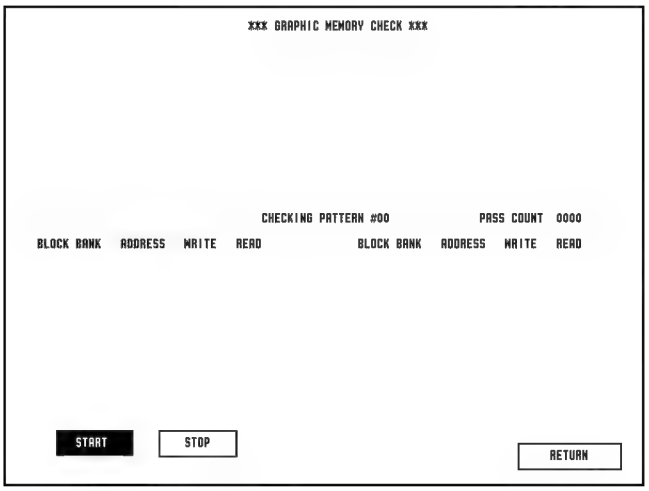
## CRTC Check Menu Items

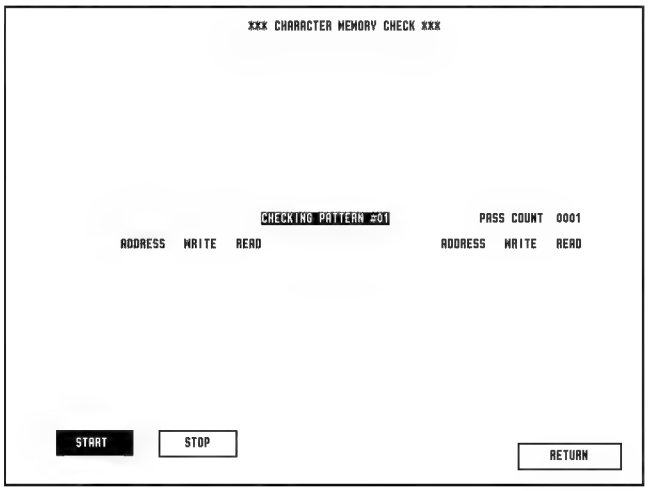
The CRTC check menu items check the function of the display control block, including the LCD unit. These check results cannot be recognized by the host CPU, so you must judge the result.

If an error is found, the MAIN board will be faulty.

### GRAPHIC MEMORY Check and CHARACTER MEMORY Check

These items check the Graphic RAM and Character RAM on the MAIN board for the waveform display or character display by the write/read check technique. If an error is detected, the error bank, address and data are displayed as a table.




***Procedure to Start the GRAPHIC MEMORY Check and CHARACTER MEMORY Check Program***

1. To select the GRAPHIC MEMORY Check or CHARACTER MEMORY Check, touch the "GRAPHIC MEMORY CHECK" or "CHARACTER MEMORY CHECK" key.

   The "START" key is highlighted to indicate the process of checking.

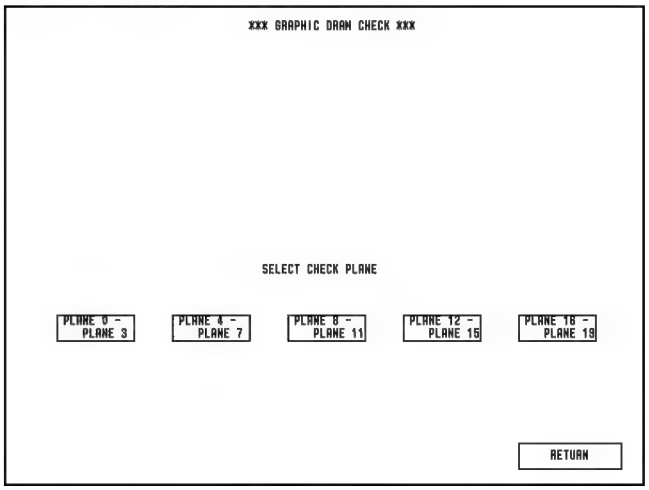
2. If the check program finds an error, it displays the address (and block bank), write data and read data as shown in the above table.

3. To stop the check temporarily, touch the "STOP" key. The "START" key name changes to normal and the "STOP" key is highlighted.

   To continue the check, touch the "START" key again.

4. To return to the MANUAL CHECK MENU screen, touch the "RETURN" key.

### GRAPHIC DRAW Check


xxx GRAPHIC DRAW CHECK xxx
SELECT CHECK PLANE
PLANE 0 - PLANE 3
PLANE 4 - PLANE 7
PLANE 8 - PLANE 11
PLANE 12 - PLANE 15
PLANE 16 - PLANE 19
RETURN

This item checks the function of the graphic draw plane. Check the figure of display and colors. At the same time, it checks for defects of LCD pixels all over the screen.

The plane for wave/graphic screen is in 20 screens and the check program displays 4 planes at a time.

If the screen has a wrong display, the MAIN board or LCD unit will be faulty.

***Procedure to Execute the GRAPHIC DRAW Check Program***

1. To select the Check, touch the "GRAPHIC DRAW CHECK" key.

   Touch the "PLANE 0 - PLANE 3" to "PLANE 16 - PLANE 19" key to display the plane combination.

2. When the program starts, it draws the grid line first. If you touch the screen, the pattern changes to the triangular waveform.

   After touching the screen again, the pattern on the screen is displayed all over the screen. The patterns are changed every time the screen is touched.

3. By rotating the upper function dial, the displaying plane(s) change, such as 0, 1, 2, 3 or ALL (the number depends on the plane combination).

   To select the waveform to be modified, rotate the lower function dial.

   The displayed color can be changed by pressing the SILENCE ALARMS key.

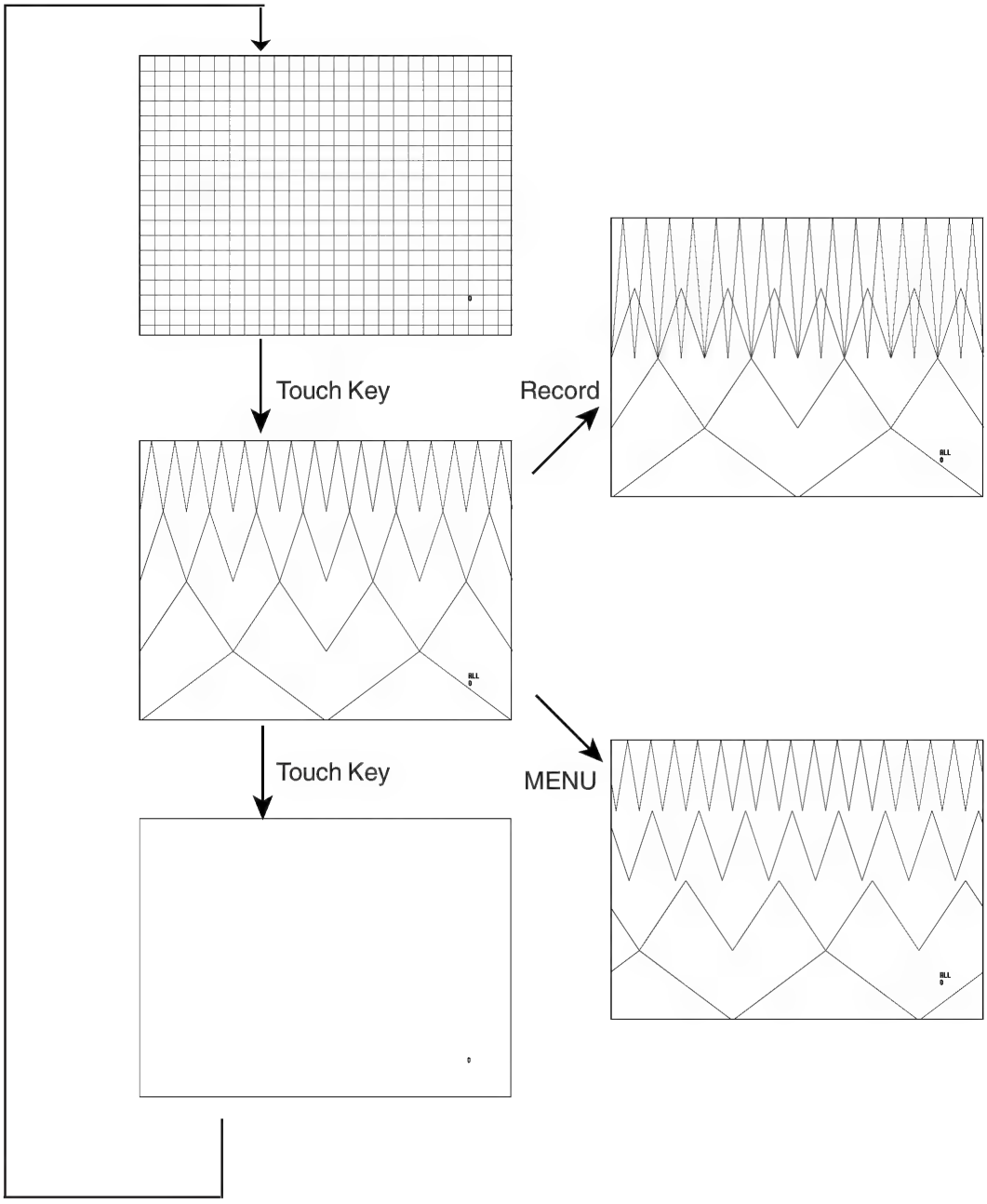
4. At the triangular waveform display mode, you can scroll the waveform by pressing the MENU key.

   Press the RECORD key to change the amplitude of each waveform.

5. To return to the GRAPHIC DRAW CHECK screen, press the HOME key.

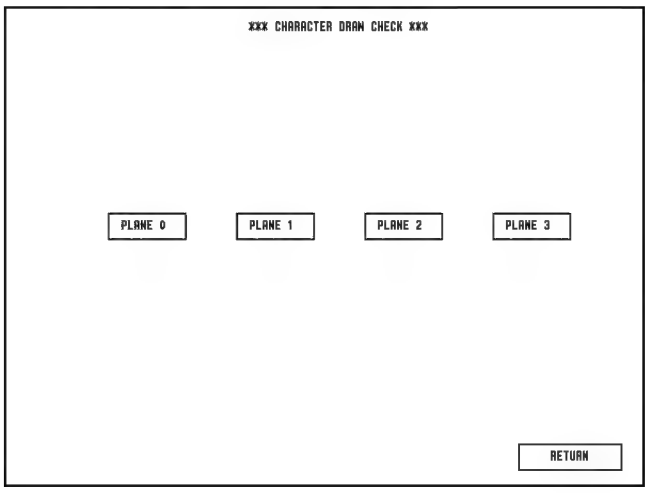
6. To return to the MANUAL CHECK MENU screen, touch the "RETURN" key.

**Screen Flow of GRAPHIC DRAW Check Program**




For the TFT LCD screen, it is considered normal if some pixels have randomly abnormal color or do not light. (Up to 25 wrong pixels are considered normal at the maximum brightness.)

### CHARACTER DRAW Check




This item checks the function of the character draw plane. Check the character display and colors. The plane for character screen is prepared in 4 screens and the check program displays one plane at a time.

***Procedure to Execute the CHARACTER DRAW Check Program***

1. To select the CHARACTER DRAW Check, touch the "CHARACTER DRAW CHECK" key and select a plane.

2. When the program starts, it draws the green characters on the black plane.

   Touch the "CHANGE BACK COLOR" key to reverse the plane color.

   If you press the MENU key, you can change the display mode in order of normal → blink → reverse → reverse/blink → normal.

3. By rotating the upper function dial, the displaying character size changes.

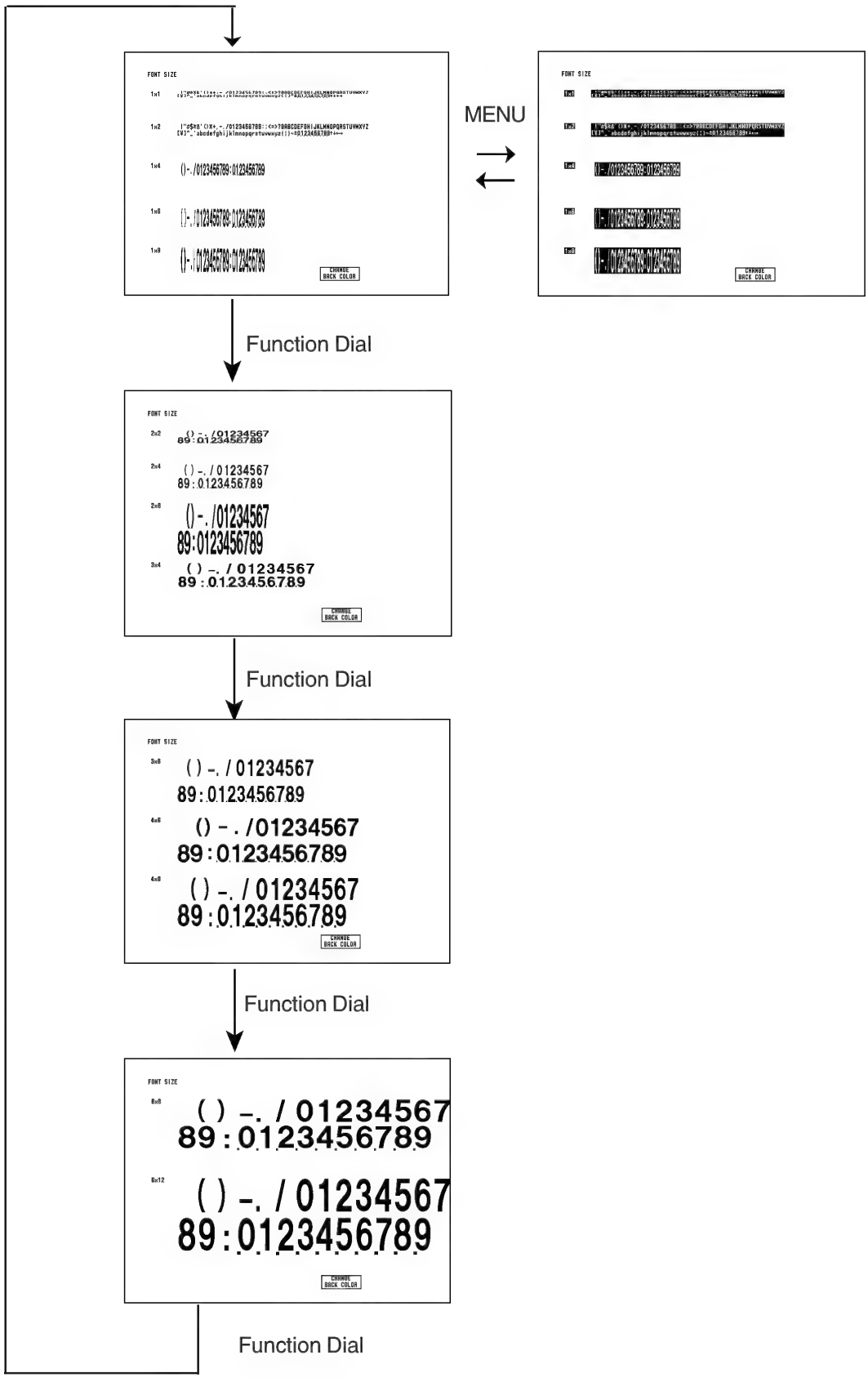
   The displayed color can be changed by pressing the SILENCE ALARMS key.

4. To return to the CHARACTER DRAW CHECK screen, press the HOME key.

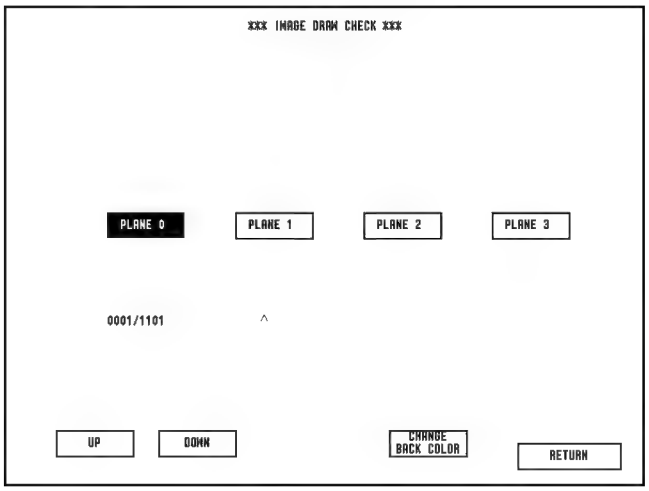
5. To return to the MANUAL CHECK MENU screen, touch the "RETURN" key.

If the screen has a wrong display, the MAIN board or LCD unit will be faulty.

## Screen Flow of CHARACTER DRAW Check Program



### IMAGE DRAW Check




This item checks the function of the image draw. All the icons and messages, bitmap images, are displayed one by one. Check the image of the display and background colors.

This function helps multi-language capability.

***Procedure to Execute the IMAGE DRAW Check Program***

1. To select the IMAGE DRAW Check, touch the "IMAGE DRAW CHECK" key. Touch the "CHANGE BACK COLOR" key to reverse the plane color.

2. When the program starts, it draws the white image on the black plane.

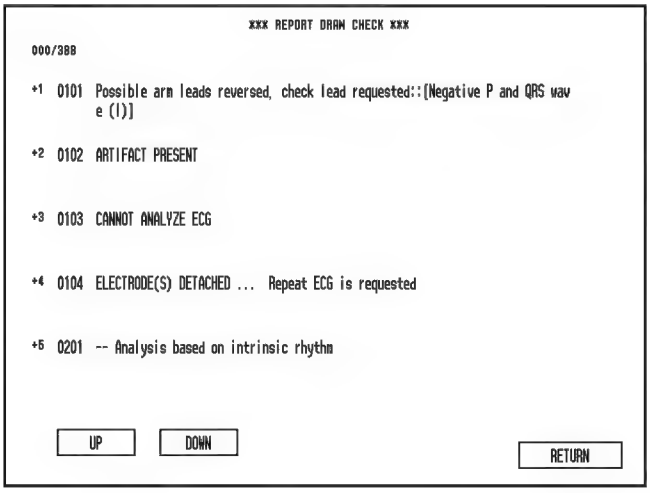
3. By rotating the lower function dial, the displaying image changes by ten.

   By rotating the upper dial, the image changes one by one. Using the "UP" or "DOWN" key on the screen also changes the image one by one.

4. To return to the MANUAL CHECK MENU screen, touch the "RETURN" key.

If the screen has a wrong display, the MAIN board or LCD unit will be faulty.

## REPORT DRAW Check


xxx REPORT DRAW CHECK xxx
000/388
*1 0101 Possible arm leads reversed, check lead requested::[Negative P and QRS wav
e (I)]
*2 0102 ARTIFACT PRESENT
*3 0103 CANNOT ANALYZE ECG
*4 0104 ELECTRODE(S) DETACHED ... Repeat ECG is requested
*5 0201 -- Analysis based on intrinsic rhythm
UP
DOWN
RETURN

This item checks the function of the report draw. 388 findings of the 12 lead ECG analysis can be displayed on the screen every 5 or 10 findings as shown below.

This function helps multi-language capability.

***Procedure to Execute the REPORT DRAW Check Program***

1. Touch the "REPORT DRAW CHECK" key on the screen. The REPORT DRAW CHECK screen appears.

2. Turn the upper function dial to scroll the findings every 10 findings.
   To scroll the findings every 5 findings, use the lower function dial or "UP" or "DOWN" key on the screen.

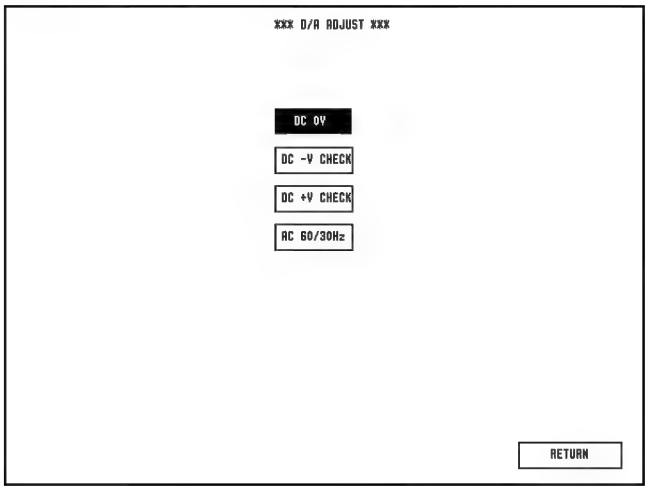
3. To return to the MANUAL CHECK MENU screen, touch the "RETURN" key.

If the screen has an incorrect display, the MAIN board or LCD unit is faulty.

## DPU Check Menu Items

The DPU board is a separate subsystem from the MAIN board. The DPU board consists of CPU, ROMs, RAMs, A to D converter and DMA.

### D/A ADJUST




This item is used to check the output voltage level of the D/A converter.

Connect a digital multimeter or oscilloscope to the ZS-900P socket (Pin 1: Analog output, Pin 2: Ground) and check the following output signals.

| | D to A output |
|---|---|
| DC 0 V | 0 V ±10 mV |
| DC –V CHECK | –5.120 V ±1% |
| DC +V CHECK | +5.1175 V ±1% |
| AC 60/30 Hz | 60 Hz ±5%, 6 Vp-p ±5% |

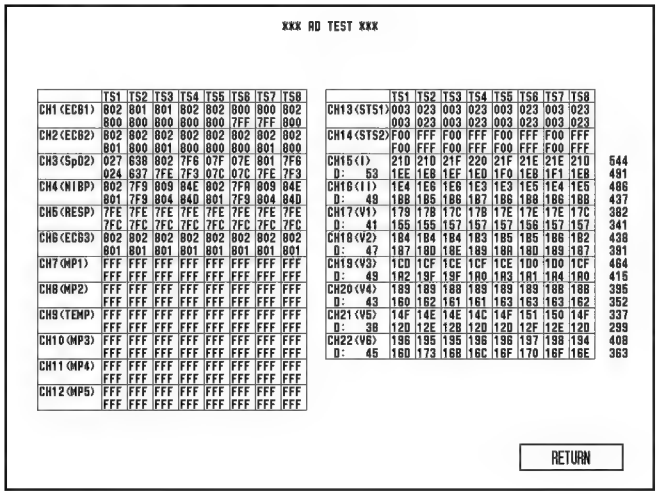
***Procedure to Start the D/A Adjust Check***

1. To select the D/A Adjust Check, touch the "D/A ADJUST" key at the DPU CHECK column. The program outputs 0 V DC.
   The "DC 0V" key is highlighted to indicate the status of output.

2. To change the output voltage or waveform, touch each name of the other keys.

3. To return to the MANUAL CHECK MENU screen, touch the "RETURN" key.

## AD TEST




| | TS1 | TS2 | TS3 | TS4 | TS5 | TS6 | TS7 | TS8 |
|---|---|---|---|---|---|---|---|---|
| CH1 (ECG1) | 802 | 801 | 801 | 802 | 802 | 800 | 800 | 802 |
| | 800 | 800 | 800 | 800 | 800 | 7FF | 7FF | 800 |
| CH2 (ECG2) | 802 | 802 | 802 | 802 | 802 | 802 | 802 | 802 |
| | 801 | 800 | 801 | 800 | 800 | 800 | 801 | 800 |
| CH3 (SpO2) | 027 | 638 | 802 | 7F6 | 07F | 07E | 801 | 7F6 |
| | 024 | 637 | 7FE | 7F3 | 07C | 07C | 7FE | 7F3 |
| CH4 (NIBP) | 802 | 7F9 | 809 | 84E | 802 | 7FA | 809 | 84E |
| | 801 | 7F9 | 804 | 84D | 801 | 7F9 | 804 | 84D |
| CH5 (RESP) | 7FE | 7FE | 7FE | 7FE | 7FE | 7FE | 7FE | 7FE |
| | 7FC | 7FC | 7FC | 7FC | 7FC | 7FC | 7FC | 7FC |
| CH6 (ECG3) | 802 | 802 | 802 | 802 | 802 | 802 | 802 | 802 |
| | 801 | 801 | 801 | 801 | 801 | 801 | 801 | 801 |
| CH7 (MP1) | FFF | FFF | FFF | FFF | FFF | FFF | FFF | FFF |
| | FFF | FFF | FFF | FFF | FFF | FFF | FFF | FFF |
| CH8 (MP2) | FFF | FFF | FFF | FFF | FFF | FFF | FFF | FFF |
| | FFF | FFF | FFF | FFF | FFF | FFF | FFF | FFF |
| CH9 (TEMP) | FFF | FFF | FFF | FFF | FFF | FFF | FFF | FFF |
| | FFF | FFF | FFF | FFF | FFF | FFF | FFF | FFF |
| CH10 (MP3) | FFF | FFF | FFF | FFF | FFF | FFF | FFF | FFF |
| | FFF | FFF | FFF | FFF | FFF | FFF | FFF | FFF |
| CH11 (MP4) | FFF | FFF | FFF | FFF | FFF | FFF | FFF | FFF |
| | FFF | FFF | FFF | FFF | FFF | FFF | FFF | FFF |
| CH12 (MP5) | FFF | FFF | FFF | FFF | FFF | FFF | FFF | FFF |
| | FFF | FFF | FFF | FFF | FFF | FFF | FFF | FFF |

| | TS1 | TS2 | TS3 | TS4 | TS5 | TS6 | TS7 | TS8 | |
|---|---|---|---|---|---|---|---|---|---|
| CH13 (STS1) | 003 | 023 | 003 | 023 | 003 | 023 | 003 | 023 | |
| | 003 | 023 | 003 | 023 | 003 | 023 | 003 | 023 | |
| CH14 (STS2) | F00 | FFF | F00 | FFF | F00 | FFF | F00 | FFF | |
| | F00 | FFF | F00 | FFF | F00 | FFF | F00 | FFF | |
| CH15 (I) | 21D | 21D | 21F | 220 | 21F | 21E | 21E | 21D | 544 |
| D: 53 | 1EE | 1E8 | 1EF | 1E0 | 1F0 | 1E8 | 1F1 | 1E8 | 491 |
| CH16 (II) | 1E4 | 1E6 | 1E6 | 1E3 | 1E3 | 1E5 | 1E4 | 1E5 | 486 |
| D: 49 | 1BB | 1B5 | 1B6 | 1B7 | 1B6 | 1B8 | 1B6 | 1BB | 437 |
| CH17 (V1) | 179 | 178 | 17C | 17B | 17E | 17E | 17E | 17C | 382 |
| D: 41 | 155 | 155 | 157 | 157 | 157 | 158 | 157 | 157 | 341 |
| CH18 (V2) | 1B4 | 1B4 | 1B4 | 1B3 | 1B5 | 1B5 | 1B6 | 1B2 | 438 |
| D: 47 | 187 | 18D | 18E | 189 | 18A | 18D | 189 | 187 | 391 |
| CH19 (V3) | 1CD | 1CF | 1CE | 1CF | 1CE | 1DD | 1DD | 1CF | 464 |
| D: 48 | 1B2 | 19F | 19F | 190 | 193 | 191 | 194 | 190 | 415 |
| CH20 (V4) | 189 | 189 | 188 | 189 | 189 | 189 | 188 | 188 | 395 |
| D: 43 | 160 | 162 | 161 | 161 | 163 | 163 | 163 | 162 | 352 |
| CH21 (V5) | 14F | 14E | 14E | 14C | 14F | 151 | 150 | 14F | 337 |
| D: 38 | 12D | 12E | 12B | 12D | 12D | 12F | 12E | 12D | 299 |
| CH22 (V6) | 196 | 195 | 195 | 196 | 196 | 197 | 198 | 194 | 408 |
| D: 45 | 160 | 173 | 168 | 16C | 16F | 170 | 16F | 16E | 363 |

This is not a check. The AD Test table shows the A to D converted values of all the analog parameters such as ECG, $SpO_2$ and NIBP. The other parameters are shown on the Multi Parameter Unit Check.

Each vital sign data are read from the A to D converter every 2 ms. The maximum and minimum data of each vital sign data are displayed every 512 ms.

ECG1: ECG waveform data (Reserved)
ECG2: ECG waveform data for ZS-900P
SpO2: Plethysmographic pulse wave data
NIBP: NIBP measurement data
RESP: Respiration waveform data
ECG3: ECG waveform data for analog output
MP1: Multi-parameter 1 socket input data
MP2: Multi-parameter 2 socket input data
TEMP: Temperature socket input data
MP3: Multi-parameter 3 socket input data
MP4: Multi-parameter 4 socket input data
MP5: Multi-parameter 5 socket input data

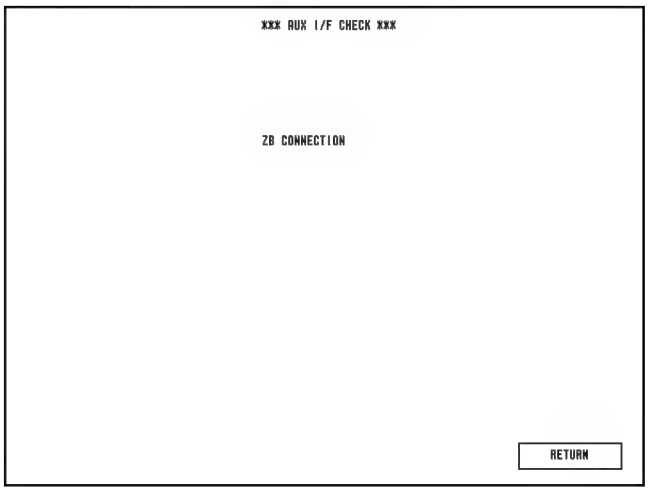
STS1: 12 lead ECG status 1 data from the CPU on the ECG RESP3 board
STS2: 12 lead ECG status 2 data from the CPU on the ECG RESP3 board
I: Lead I waveform data of 12 lead ECG
II: Lead II waveform data of 12 lead ECG
V1: Lead V1 waveform data of 12 lead ECG
V2: Lead V2 waveform data of 12 lead ECG
V3: Lead V3 waveform data of 12 lead ECG
V4: Lead V4 waveform data of 12 lead ECG
V5: Lead V5 waveform data of 12 lead ECG
V6: Lead V6 waveform data of 12 lead ECG

***Procedure to start the AD Test***

1. To select the AD Test, touch the "AD TEST" key at the DPU CHECK column. The program shows above table automatically.

2. To return to the MANUAL CHECK MENU screen, touch the "RETURN" key.

## AUX I/F Check




This check is used to check the connection with the ZS-900PK transmitter.

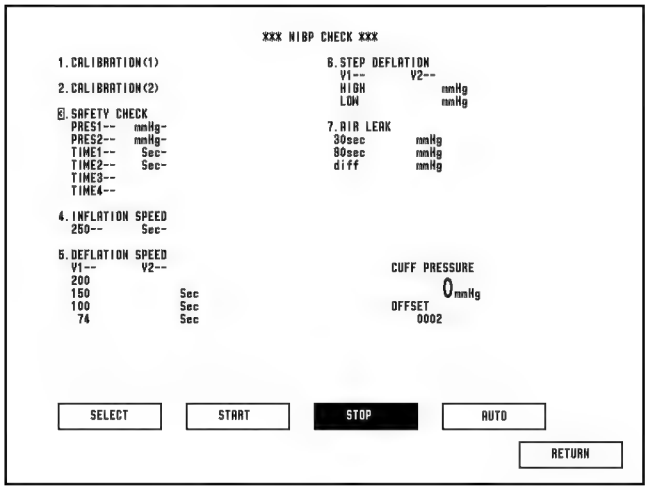
***Procedure to start the AUX I/F Check***

1. To select the AUX I/F Check, touch the "AUX I/F CHECK" key at the DPU CHECK column.
   The instrument communicates with the transmitter and if it recognized the connection with the transmitter, indicates "ZB CONNECTION".

2. If there is no connection with the transmitter, the instrument indicates "ZB NO CONNECTION".

3. To return to the MANUAL CHECK MENU screen, touch the "RETURN" key.

### NIBP Check




This item checks the function and safety of NIBP circuit and pump. The NIBP check consist of the following check items:

1) Calibration (1)
2) Calibration (2)
3) Safety Check
4) Inflation Speed
5) Deflation Speed
6) Step Deflation
7) Air leak

To perform the test, prepare the following tools:

Hand bulb pump
Manometer
Y-shape hose connector (The Y-shape hose connector connects one tube of the dummy cuff to the handbulb pump and manometer.)
700 ml dummy cuff YS-558R9 (A 700 ml dummy cuff is a solid container that withstands high pressure. The inner volume of this container must be 700 ml.)
250 ml dummy cuff YS-564R2
Two 3.5 m air hoses (YN-901P and YN-921P)

***Procedure to select the item and start the NIBP Check***

1. To select the NIBP Check, touch the "NIBP CHECK" key at the DPU CHECK column. The program changes the screen to the NIBP CHECK.

2. Touch the "SELECT" key to select the check item number.

3. Touch the "START" key to start the check for the selected check item.

**NOTE**

**Make sure there is no pressure applied on the cuff connector before pressing the "START" key. The program considers the pressure of the cuff connector as 0 mmHg at the start of the check.**

4. To return to the MANUAL CHECK MENU screen, touch the "RETURN" key.

### 1. Calibration (1)

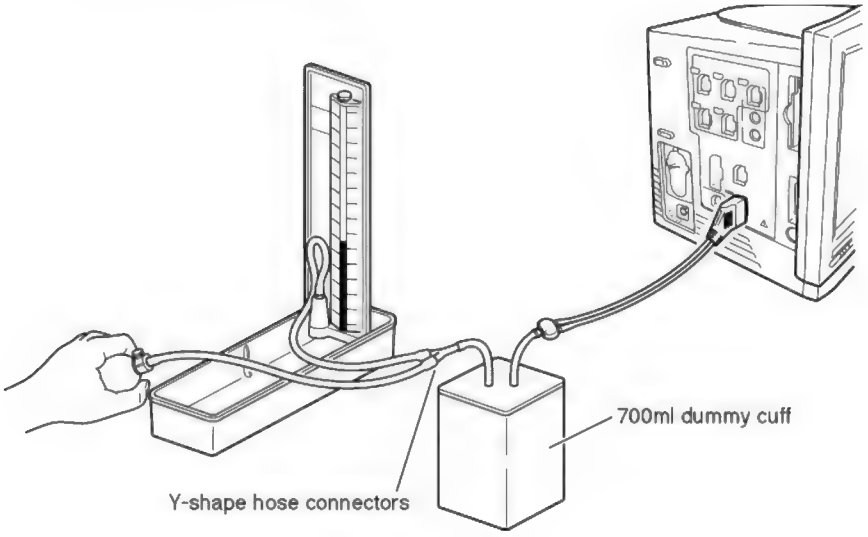
The Calibration (1) Check program is not used for calibration but is used to display the accuracy of the Pressure Sensor 1. The accuracy of the sensor changes with the measuring pressure. The following table shows the acceptable accuracy range of the Pressure Sensor 1 at different pressure ranges.

<Acceptable Accuracy Range of Pressure Sensor 1 at Different Pressure Ranges>

| Pressure Range | Acceptable Accuracy Range |
|---|---|
| 0 - 199 mmHg | +/–3 mmHg |
| 200 - 300 mmHg | +/–4 mmHg |

**Checking the Accuracy of Pressure Sensor 1**

1. Connect the manometer and hand bulb pump to the dummy cuff using the Y-shape connector and connect the dummy cuff to the instrument with the air hose as shown below.




2. Touch the "SELECT" key to select item number 1.

3. Touch the "START" key to start the check.

4. Immediately start pumping the hand bulb pump. Stop pumping the hand bulb pump when the pressure reading displayed on the NIBP Check display of the instrument is within one of the two pressure ranges. ( 0 - 199 or 200 - 300 mmHg ).

5. Compare the pressure reading displayed on the NIBP Check display with the pressure reading on the manometer.

6. Repeat steps 4 and 5 for a reading in the other pressure range.

   If the accuracy of the pressure sensor for any of the two pressure ranges is out of the acceptable accuracy range, replace the NIBP Measure board or pneumatic circuit with a new one.

### 2. Calibration (2)

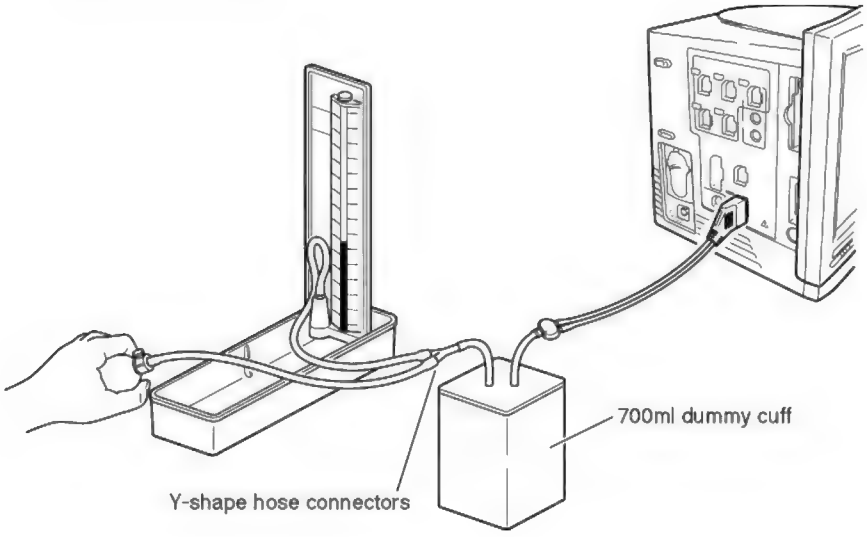
The Calibration (2) Check program is not used for calibration but is used to display the accuracy of the Pressure Sensor 2. The accuracy of the sensor changes with the measuring pressure. The following table shows the acceptable accuracy range of the Pressure Sensor 2 at different pressure ranges.

<Acceptable Accuracy Range of Pressure Sensor 2 at Different Pressure Ranges>

| Pressure Range | Acceptable Accuracy Range |
|---|---|
| 0 - 15 mmHg | –2 mmHg to +3 mmHg |
| 16 - 200 mmHg | +/–8 mmHg |
| 201 - 300 mmHg | +/–12 mmHg |

**Checking the Accuracy of Pressure Sensor 2**

1. Connect the manometer and hand bulb pump to the dummy cuff using the Y-shape connector and connect the dummy cuff to the instrument with the air hose as shown below.




2. Touch the "SELECT" key to select item number 2.

3. Touch the "START" key to start the check.

4. Immediately start pumping the hand bulb pump. Stop pumping the hand bulb pump when the pressure reading displayed on the NIBP Check display of the instrument is within one of the three pressure ranges. ( 0 - 15, 16 - 200 or 201 - 300 mmHg).

5. Compare the pressure reading displayed on the NIBP Check display with the pressure reading on the manometer.

6. Repeat steps 4 and 5 for a reading in the other pressure range.

   If the accuracy of the pressure sensor for any of the three pressure ranges is out of the acceptable accuracy range, replace the NIBP Safety board or pneumatic circuit with a new one.

### 3. Safety Check

There are the following 6 check items monitored by the NIBP safety circuit.

<Description and Acceptable Range of Check item>

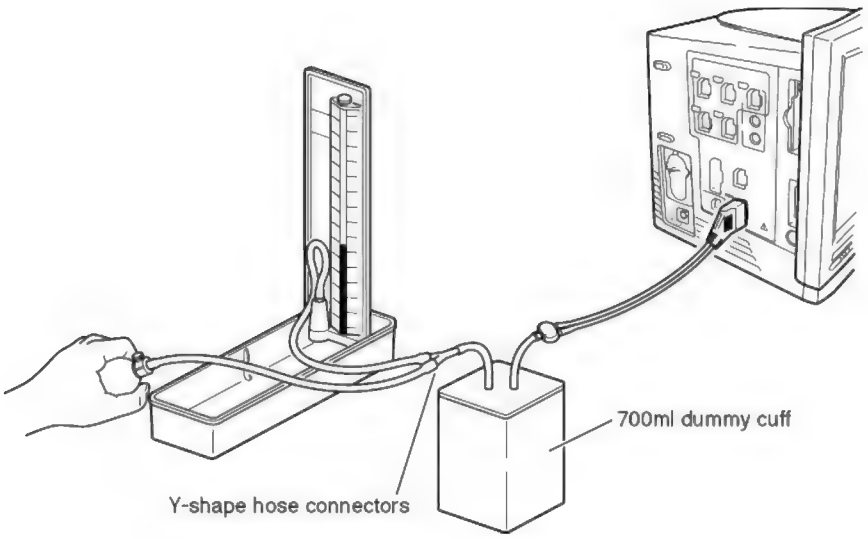
| Check item | Description | Range |
|---|---|---|
| PRESS 1 | Pressure limiter in the adult mode | 315 +/– 15 mmHg |
| PRESS 2 | Pressure limiter in the neonatal mode | 157.5 +/– 7.5 mmHg |
| TIME 1 | Time limiter in the adult mode | 176 - 180 sec ( >15 mmHg ) |
| TIME 2 | Time limiter in the neonatal mode | 86 - 90 sec ( >5 mmHg ) |
| TIME 3 | Interval error in the adult mode | >=10 sec ( >15 mmHg ) |
| TIME 4 | Interval error in the neonatal mode | >=10 sec ( >5 mmHg ) |

**NOTE**

**Since the TIME 1 to TIME 4 checks require a pressure generator which supplies a pressure such as more than 5 mmHg or more than 15 mmHg during a certain period such as 3 or 1.5 minutes or supplies the pressure at a certain interval such as 10 seconds, do not perform these checks locally.**

Connect the manometer and hand bulb pump to the dummy cuff using the Y-shape connector and connect the dummy cuff to the instrument with the air hose as shown below.

For the PRESS 1, use the YN-901P air hose.
For the PRESS 2, use the YN-921P air hose.



**Checking the PRESS 1 Safety Check Item**

1. Touch the "SELECT" key to select the item number 3.

2. Touch the "AUTO" key until the key name changes to "PRESS 1" so that the PRESS 1 Safety Check item is selected.

3. Touch the "START" key to start the check.

4. Start pumping the hand bulb pump as soon as the "CHECK" message appears.

5. Quickly increase the pressure until the manometer reads 300 mmHg. From the 300 mmHg pressure point, slowly increase the pressure further. Check that the "OK" message appears after the inflated pressure reaches a certain value in the 300 to 330 mmHg range. When the "OK" message appears, the "SAFETY CIRCUIT ON" message also appears in the cuff pressure window.

**NOTE**

- **If the pressure is raised too quickly to a value above 330 mmHg, the "ERROR" message appears.**
- **Slowly increasing the pressure after the 300 mmHg pressure point triggers the safety circuit to display the "OK" message within 30 seconds. If the pressure is maintained at 300 mmHg, the "OK" or "ERROR" message appears after 3 minutes because of triggering of a TIME1 safety event.**

If an "ERROR" message appears, replace the NIBP Safety board or pneumatic circuit with a new one.

**Checking the PRESS 2 Safety Check Item**

1. Touch the "SELECT" key to select item number 3.

2. Touch the "AUTO" key until the key name changes to "PRESS 2" so that the PRESS 2 Safety Check item is selected.

3. Touch the "START" key to start the check.

4. Start pumping the hand bulb pump as soon as the "CHECK" message appears.

5. Quickly increase the pressure until the manometer reads 150 mmHg. From the 150 mmHg pressure point, slowly increase the pressure further. Check that the "OK" message appears after the inflated pressure reaches a certain value in the 150 to 165 mmHg range. When the "OK" message appears, the "SAFETY CIRCUIT ON" message also appears in the cuff pressure window.

**NOTE**

- **If the pressure is raised too quickly to a value above 165 mmHg, the "ERROR" message appears.**
- **Slowly increasing the pressure after the 150 mmHg pressure point triggers the safety circuit to display the "OK" message within 30 seconds. If the pressure is maintained at 150 mmHg, the "OK" or "ERROR" message appears after 3 minutes because of triggering of a TIME1 safety event.**

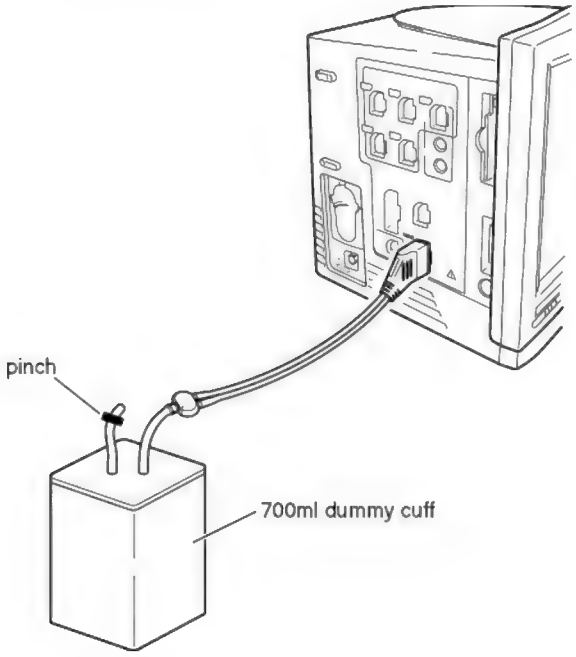
If an "ERROR" message appears, replace the NIBP Safety board or pneumatic circuit with a new one.

### 4. Inflation Speed

This is used to check the inflation speed of the pressure pump. The specifications state that the cuff pressure must be able to reach 250 mmHg in less than 7 seconds.

**Checking the Inflation Speed**

1. Connect the 700 ml dummy cuff to the instrument with the 3.5 m air hose as shown below.




2. Touch the "SELECT" key to select item number 4.

3. Touch the "START" key to start the check.

   If the inflation speed is less than 7 seconds, an "OK" message appears.

   If an "ERROR" message appears, replace the NIBP Safety board or pneumatic circuit with a new one.

### 5. Deflation Speed

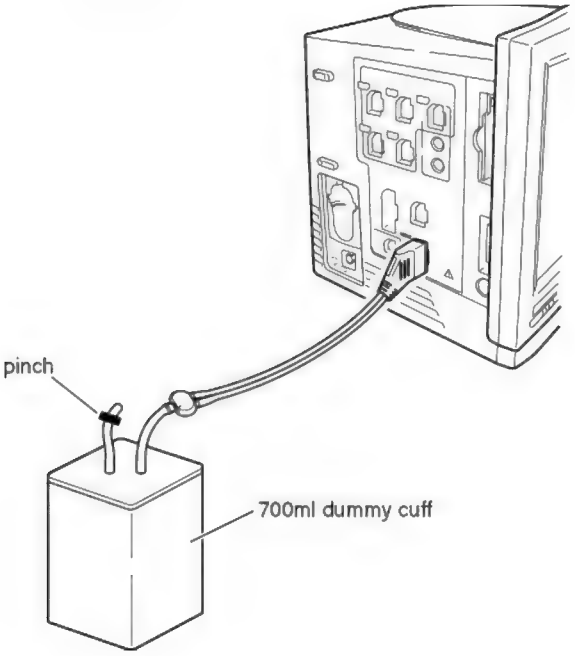
**NOTE**

**Skip this deflation speed check because it is covered in the "6. Step Deflation" check.**

This is used to check the deflation speed through the two solenoid valves (V1 and V2) at different stages of pressure drop. An "OK" message is displayed if it takes 1.4 to 3.0 seconds for V1 and 2.5 to 4.3 seconds for V2. If not, an "ERROR" message is displayed.

**Checking the Deflation Speed**

1. Connect the 700 ml dummy cuff to the instrument with the 3.5 m air hose as shown below.




2. Touch the "SELECT" key to select item number 5.

3. Touch the "START" key to start the check.

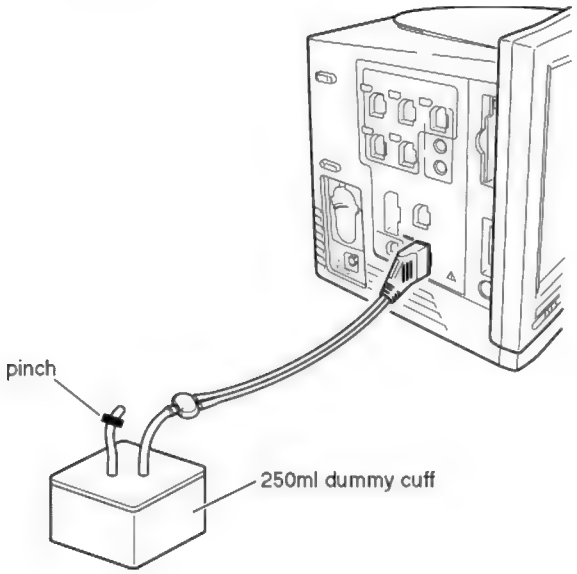
   If an "ERROR" message appears, replace the NIBP Safety board or pneumatic circuit with a new one.

### 6. Step Deflation

This checks the step deflation of the cuff at given pressure.
HIGH pressure: Valve 1 opens for 40 ms and Valve 2 opens for 70 ms at 250 mmHg.
The "OK" message appears if the pressure drop is 5 to 20 mmHg.
LOW pressure: Valve 1 opens for 60 ms and Valve 2 opens for 80 ms at 20 mmHg.
The "OK" message appears if the pressure drop is 1 to 10 mmHg.

**Checking the Step Deflation**

1. Connect the 250 ml dummy cuff to the instrument with the 3.5 m air hose as shown below.




2. Touch the "SELECT" key to select item number 6.

3. Touch the "START" key to start the check.

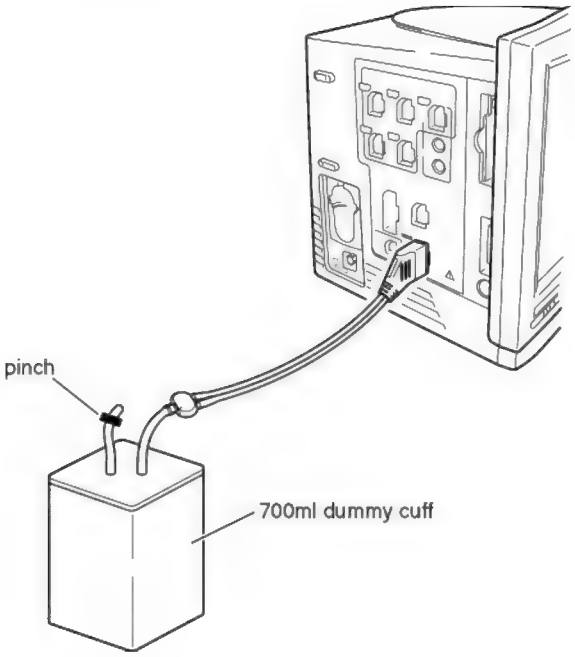
   If an "ERROR" message appears, replace the NIBP Safety board or pneumatic circuit with a new one.

### 7. Air Leak

This checks air leakage in the pneumatic circuit of NIBP module. In this check, the air pressure of the dummy cuff goes up to 300 mmHg. It then compares the pressure readings of the dummy cuff taken at 30 seconds and 90 seconds after the pressure of the dummy cuff had reached 300 mmHg. If the pressure readings differ by 5 mmHg or less, an "OK" message appears. If not, an "ERROR" message appears. In this case, make sure that the cuff connector and internal air tubes are firmly attached. If the "ERROR" message still appears, replace the NIBP Safety board or pneumatic circuit with a new one.

**Checking the Air Leak**

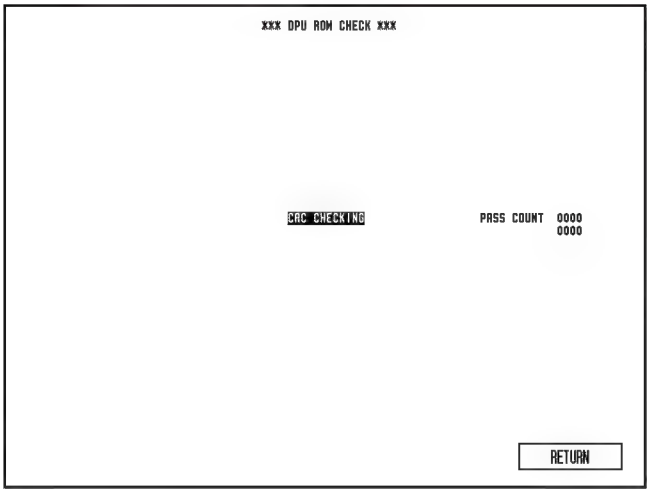
1. Connect the 700 ml dummy cuff to the instrument with the 3.5 m air hose as shown below.




2. Touch the "SELECT" key to select item number 7.

3. Touch the "START" key to start the check.

### DPU ROM Check




This item checks the ROMs on the DPU board by the CRC (cyclic redundancy check) technique. This check assigns a count number when one set of checks is successfully completed.

If an error message appears, the DPU board will be faulty.

***Procedure to Start and Exit the DPU ROM Check Program***

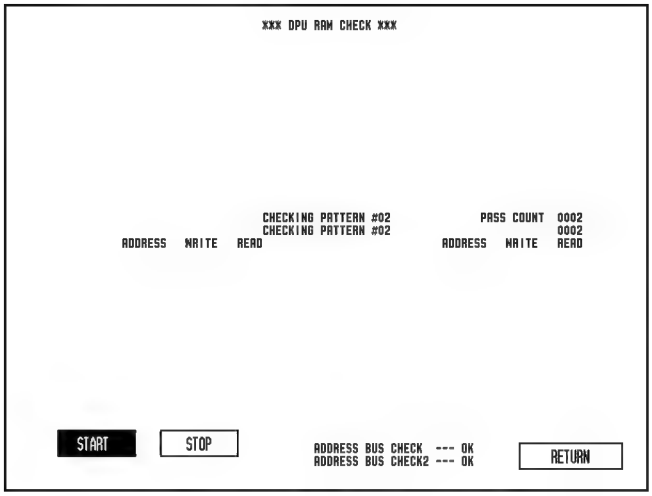
1. To select the DPU ROM Check, touch the "ROM CHECK" key at the DPU CHECK column.

2. The instrument repeats the check and increments the pass count until you touch the "RETURN" key.

3. If the check program finds an error, it displays the "ERROR" message on the screen.

4. To return to the MANUAL CHECK MENU screen at any time, touch the "RETURN" key.

### DPU RAM Check




This item checks the RAM on the DPU board by comparing the test patterns (first written to the RAM) with the test patterns (later read from the RAM).

If an error message appears, the DPU board will be faulty.

***Procedure to Start, Stop, and Exit the DPU RAM Check Program***

1. To select the DPU RAM Check, touch the "RAM CHECK" key at the DPU CHECK column. The check program automatically starts.
   The "START" key is highlighted to indicate the process of checking.

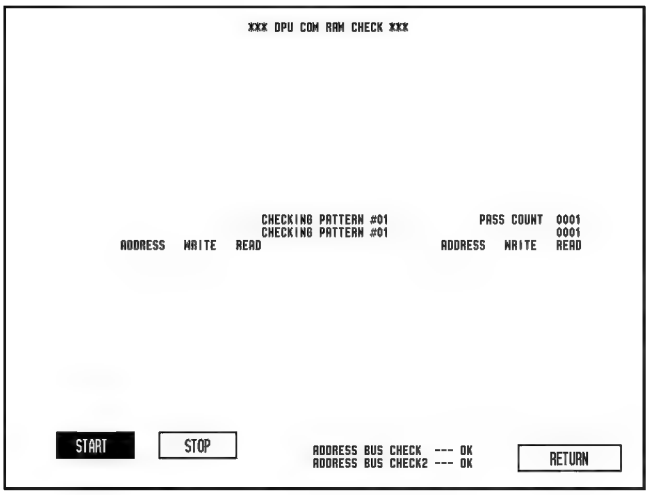
2. If the check program finds an error, it displays the address, write data and read data as above table.

3. To stop the check temporarily, touch the "STOP" key. The highlighted "START" key changes to normal and the "STOP" key is highlighted.

   To continue the check, touch the "START" key again.

4. To return to the MANUAL CHECK MENU screen, touch the "RETURN" key.

### DPU COM RAM Check




This item checks the dual port RAM for communication between the host CPU on the MAIN board and CPU on the DPU board. The check method is the same as the system RAM check. The check program indicates the address, write data and read data if an error is detected.

This RAM is located on the DPU board. Therefore if the error is detected, the DPU board will be faulty.

***Procedure to Start, Stop, and Exit the DPU COM RAM Check Program***

1. To select COM RAM Check, touch the "COM RAM CHECK" key at the DPU CHECK column. The check program automatically starts.
   The "START" key is highlighted to indicate that checking is being done.

2. If the check program finds an error, it displays the DPU part, address, write data and read data as shown in the above table.

3. To stop the check temporarily, touch the "STOP" key. The highlighted "START" key changes to normal and the "STOP" key is highlighted.

   To continue the check, touch the "START" key again.

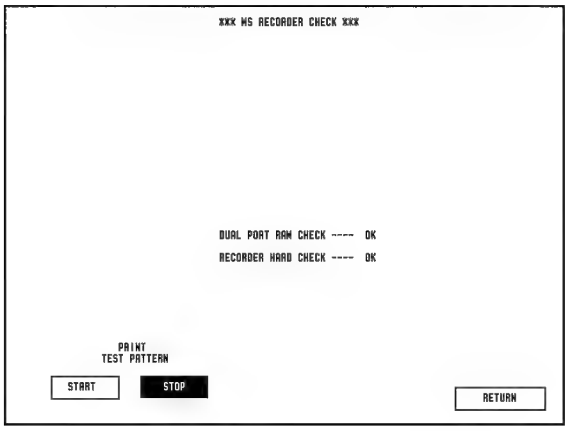
4. To return to the MANUAL CHECK MENU screen, touch the "RETURN" key.

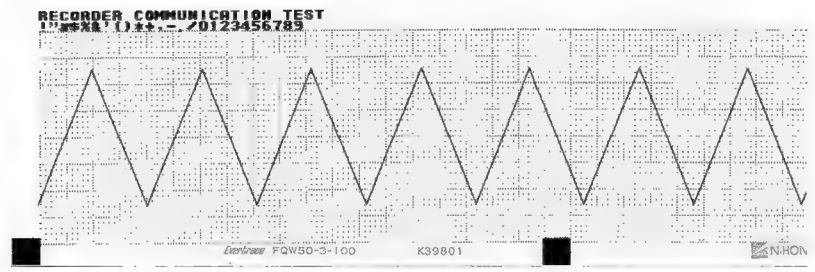
## COM Check Menu Items

The COM check menu items check the communication with peripheral units such as recorder and external equipment.

### WS RECORDER Check (When the optional recorder is installed)

This item checks the dual port RAM in the ASIC (RACOON) and the other recorder control block with the communication between the host CPU and local CPU on the MAIN board. The built-in recorder is one of the peripheral units for the host CPU. Physically, both the recorder control block and host CPU are on the MAIN board.




***Procedure to Start the WS RECORDER Check Program***

1. To select the WS RECORDER Check, touch the "WS RECORDER CHECK" key in the COM CHECK column.

   The program checks the function of the dual port memory which communicates with the host CPU and local CPU of the recorder control block and checks the other functions of the recorder control block.

2. Touch the PRINT TEST PATTERN "START" key. The host CPU communicates with the local CPU so that the above test pattern is recorded on the paper.

   The "START" key is highlighted to indicate the process of checking.

   Until you touch the "STOP" key, paper runs continuously.

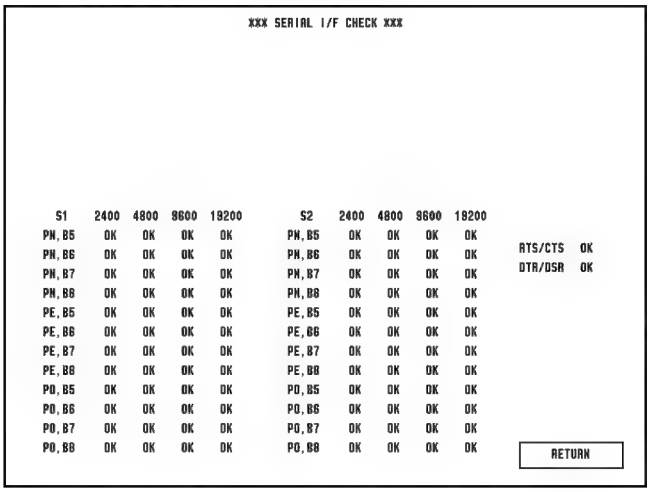
3. If the magazine is open or there is no paper, these status are displayed on the screen.

   If the status is not displayed in such condition, the MAIN board or recorder unit will be faulty.

### SERIAL I/F Check

This item checks the communication interface for external equipment such as a personal computer.

To perform this check without a personal computer, you must make the following short circuits at the AUX socket.
Pins 2 and 27
Pins 3 and 28
Pins 4 and 29


xxx SERIAL I/F CHECK xxx
S1 2400 4800 9600 19200
PN,B5 OK OK OK OK
PN,B6 OK OK OK OK
PN,B7 OK OK OK OK
PN,B8 OK OK OK OK
PE,B5 OK OK OK OK
PE,B6 OK OK OK OK
PE,B7 OK OK OK OK
PE,B8 OK OK OK OK
PO,B5 OK OK OK OK
PO,B6 OK OK OK OK
PO,B7 OK OK OK OK
PO,B8 OK OK OK OK
S2 2400 4800 9600 19200
PN,B5 OK OK OK OK
PN,B6 OK OK OK OK
PN,B7 OK OK OK OK
PN,B8 OK OK OK OK
PE,B5 OK OK OK OK
PE,B6 OK OK OK OK
PE,B7 OK OK OK OK
PE,B8 OK OK OK OK
PO,B5 OK OK OK OK
PO,B6 OK OK OK OK
PO,B7 OK OK OK OK
PO,B8 OK OK OK OK
RTS/CTS OK
DTR/DSR OK
RETURN

***Procedure to Start the SERIAL I/F Check Program***

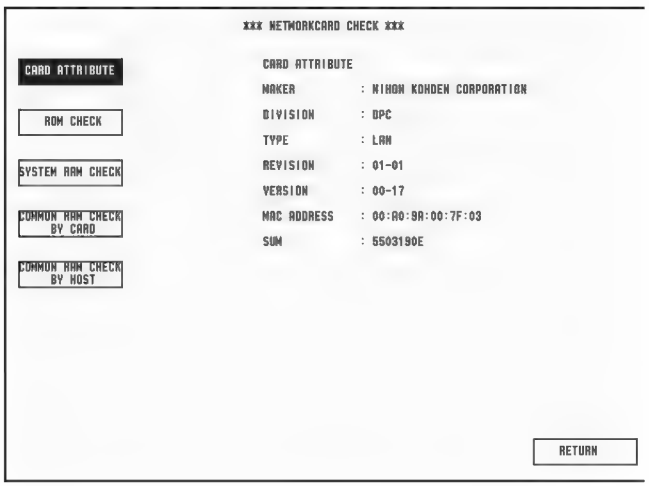
To select the SERIAL I/F Check, touch the "SERIAL I/F CHECK" key at the COM CHECK column. The check program automatically starts.

The check program changes the baud rate, data bit length and parity check condition to check the serial communication interface.

If an error message appears, the MAIN board will be faulty.

### NETWORK CARD Check

This item checks the function of the QI-101P network card and its interface. To perform this check, the optional QI-101P network card is required.




***Procedure to Start the NETWORK CARD Check Program***

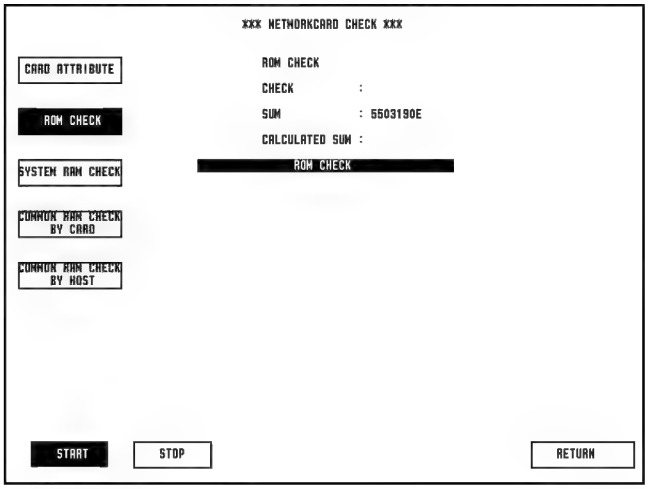
1. To select the NETWORK CARD Check, touch the "NETWORK CARD CHECK" key at the COM CHECK column.

   The check program recognizes the type of card and displays the attribute data which is memorized in the card.

   If the QI-101P network card is not inserted, the "INSERT NETWORK CARD" message appears on the screen instead of the above screen example. At that time, when you insert the network card, a few seconds later, the above screen appears automatically.

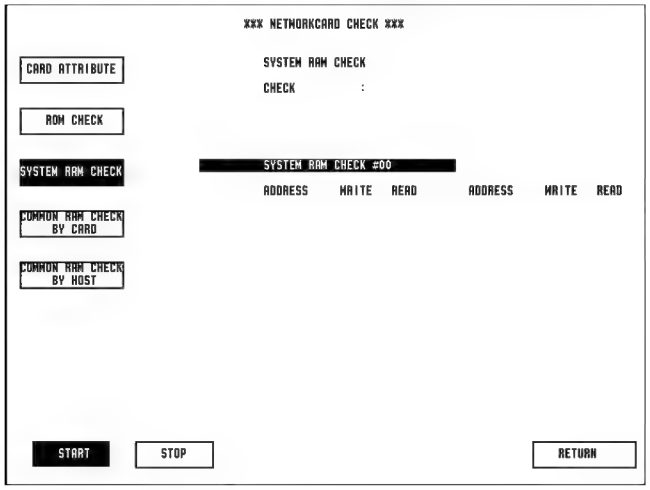
   If the check program can read the attribute data at the CARD ATTRIBUTE correctly and there is no error at the attribute data at COMMON RAM CHECK BY HOST but the instrument has no communication with the network, the network cable or hub will be faulty. If an error message appears at one of the five checks, the network card or MAIN board will be faulty.

2. Touch the "ROM CHECK" key on the screen. The CPU of the network card checks the program data of the ROM in the CPU using the check sum method and displays the check result on the following screen.

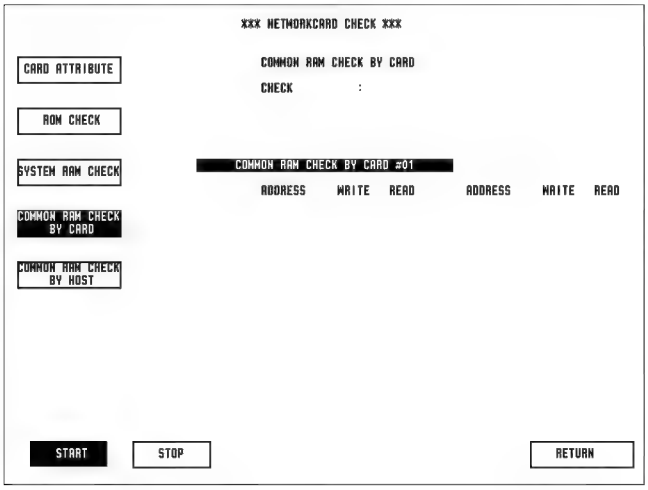


- CHECK: Displays the check result, i.e. "OK" or "ERROR". When the CALCULATED SUM data is same as the SUM data, "OK" appears.
- SUM: The sum data of the program data stored in the ROM
- CALCULATED SUM: The sum data calculated from the program data in the ROM

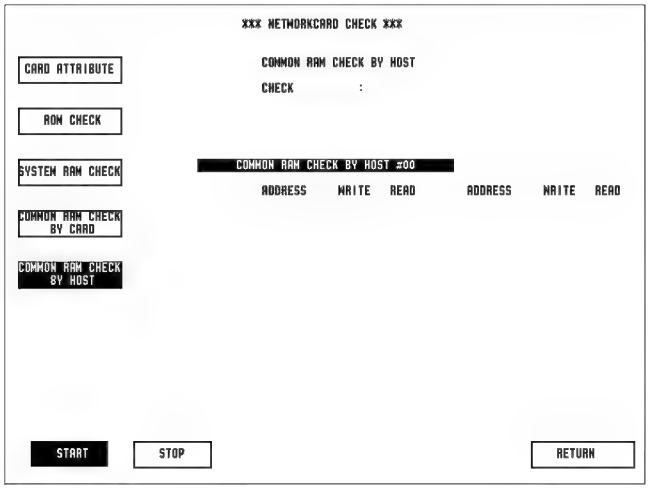
3. Touch the "SYSTEM RAM CHECK" key on the screen. The CPU of the network card checks the system RAM in the CPU by writing the check data as a pattern and reading the stored check data and comparing the written data with the read data. If an error is found, the host CPU on the MAIN board displays the address at the error occurrence, written data and read data on the following screen.




4. Touch the "COMMON RAM CHECK BY CARD" key on the screen. The CPU of the network card checks the common memory of the network card. The host CPU on the MAIN board receives the check result and displays it on the screen. If an error is found, the host CPU displays the address at the error occurrence, written data and read data on the following screen.



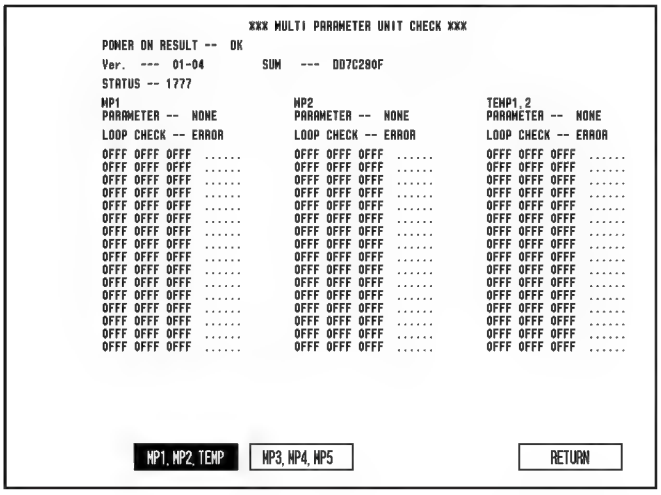
5. Touch the "COMMON RAM CHECK BY HOST" key on the screen. The host CPU on the MAIN board checks the common memory of the network card and displays the check result on the screen. If an error is found, the host CPU displays the address at the error occurrence, written data and read data on the following screen.

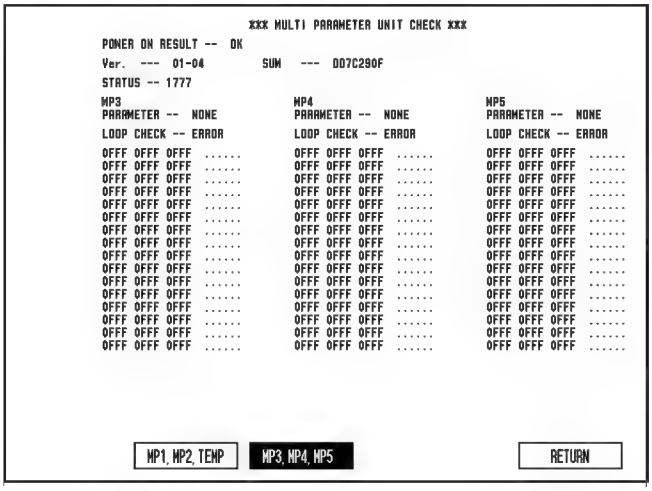



6. To return to the MANUAL CHECK MENU screen, touch the "RETURN" key.

### MULTI PARAMETER UNIT Check

This item checks the communication with the DPU board, and function and accuracy of the multi-parameter inputs. Each CPU on the two MP2 boards* sends the check result and multi-parameter socket status data to the DPU board.
*Refer to Section 1 "Board/Unit Connection Diagram".
On the following screen, note that MP1 to MP5 and TEMP are used as the input socket names.




***Procedure to Start the MULTI PARAMETER UNIT Check Program***

To select the MULTI PARAMETER UNIT Check, touch the "MULTI PARAMETER UNIT CHECK" key at the COM CHECK column.

- POWER ON RESULT: Displays the result checked by the CPU on each MP2 board at the power on self check. If an error is found, one of the following error codes appears on the screen.

| Error Code | Description | Action |
|---|---|---|
| ROM | The ROM on the MP2 board is faulty. | Replace the MP2 board with a new one. |
| RAM | The RAM on the MP2 board is faulty. | Replace the MP2 board with a new one. |
| A/D | The A to D converter on the MP2 board is faulty. | Replace the MP2 board with a new one. |

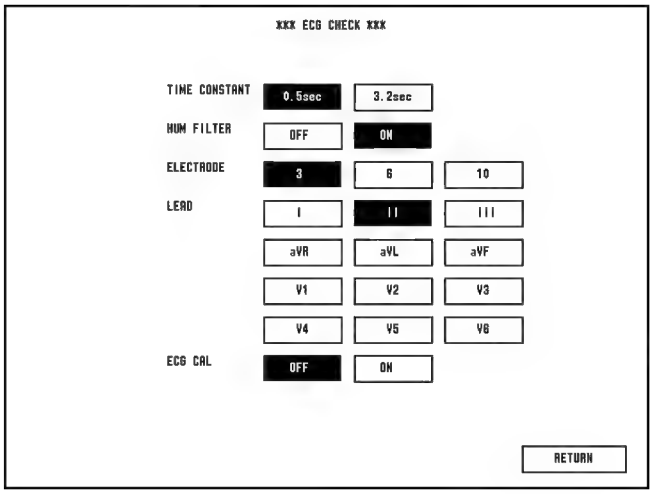
- Ver. and SUM: Displays the software version of the ROM on each MP2 board and its sum data.
- PARAMETER: Displays the vital sign parameter such as PRESS, TEMP, $CO_2$, RESP, CO or $FiO_2$ when the corresponding connection cord is connected to each multi-parameter socket. If the socket has no connection cord, "NONE" appears.
- LOOP CHECK: Displays "ERROR" when the one of the connection cords is connected to the socket or no connection cord is connected. "OK" appears only if the factory use connector for the loop check is connected to the socket.
- EEPROM data: Displays the data of the EEPROM in the connector of the connection cord when it is connected to the socket. When no connection cord is connected, all the data shows "0FFF". If there is a communication error between the DPU board and CPU on the MP2 board, all the data shows "8000". In this case, the DPU board, motherboard or MP2 board is faulty.

### ECG Check

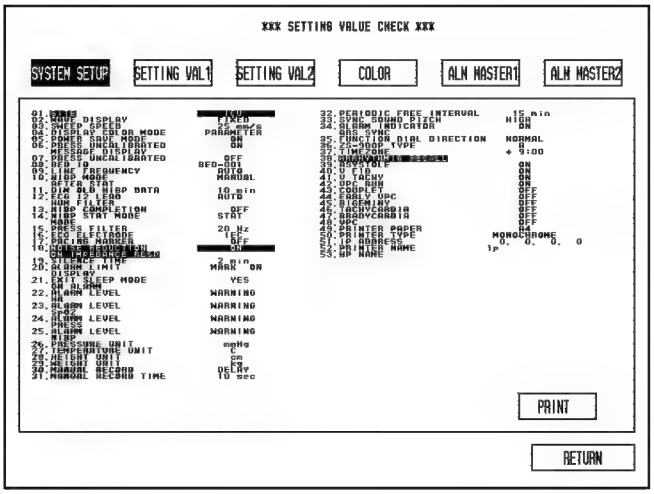
This check is for factory use.

**NOTE**

**These ECG monitoring settings do not affect the monitor mode.**



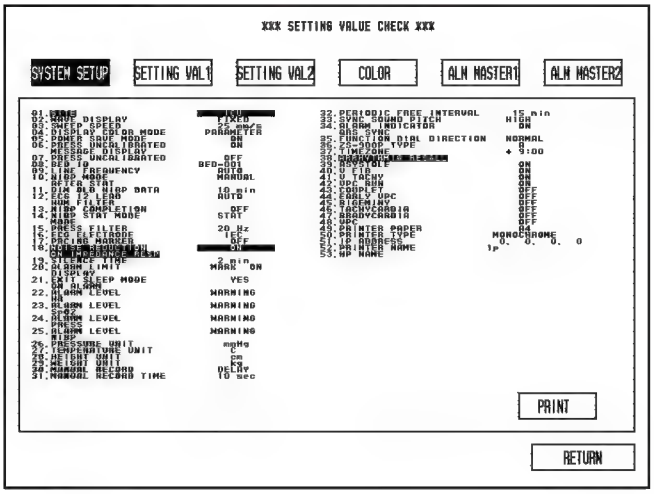
## SETTING VALUE Check



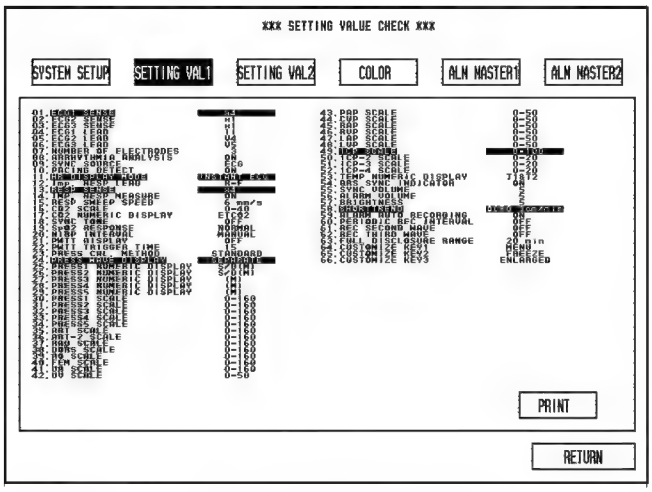

This item displays all the settings, i.e. system setup settings, settings of each parameter, display color assignment settings and alarm master settings so that you can check them. When a current setting is different from the default setting, the current setting is highlighted on the screen. The screen image can be recorded if the optional recorder is installed into the instrument.

***Procedure to Execute the SETTING VALUE Check Program***

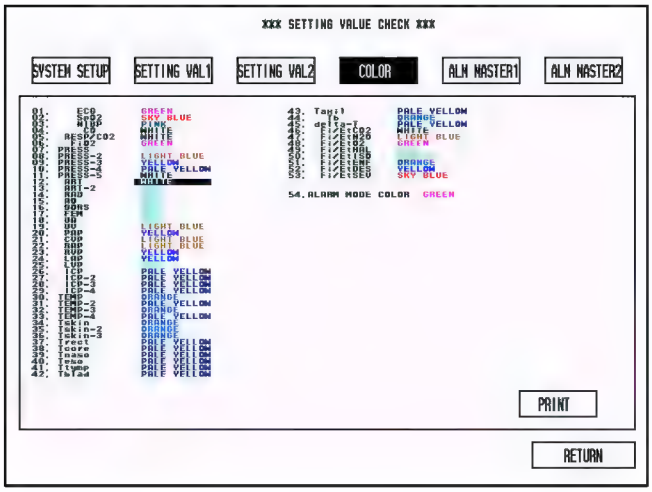
1. Touch the "SETTING VALUE CHECK" key on the screen. The SETTING VALUE CHECK screen appears.
2. To display the system setup settings as shown below, touch the "SYSTEM SETUP" key.



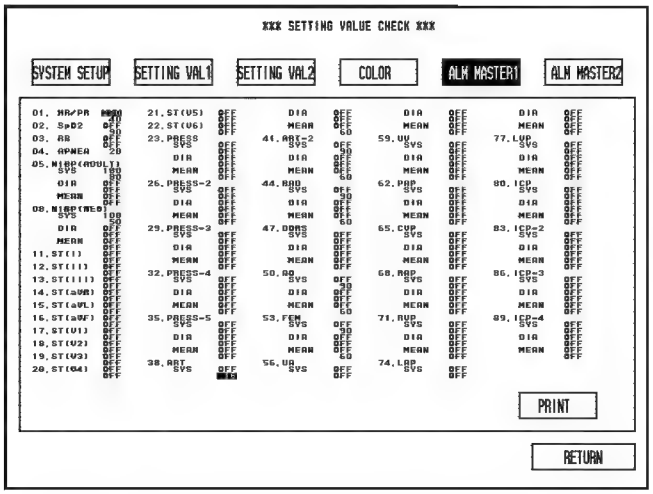
3. To display the settings of each parameter as shown below, touch the "SETTING VAL1" key.

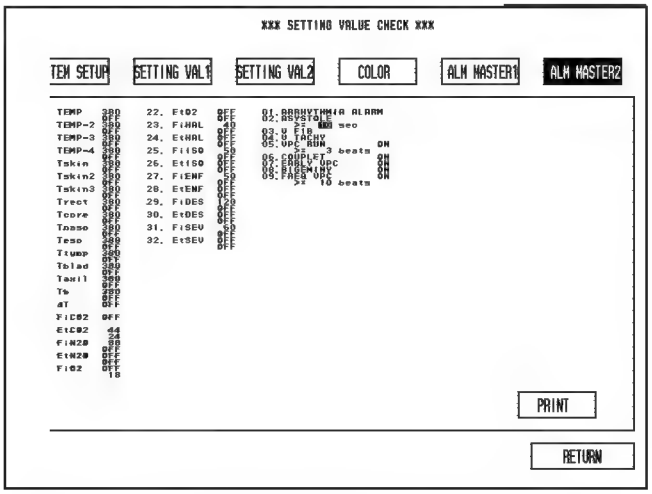



4. To display the display color assignment settings as shown below, touch the "COLOR" key.




5. To display the alarm master settings as shown below, touch the "ALM MASTER1" key or "ALM MASTER2" key.




6. To record the screen image, touch the "PRINT" key if the instrument has the optional built in recorder.
7. To return to the MANUAL CHECK MENU screen, touch the "RETURN" key.

## Recorder and Control Block Checks (When the optional recorder is installed)

This check program checks the thermal array recorder and recorder control block on the MAIN board without communication with the host CPU. Therefore, this check is independent from the manual check menu.

This check allows you to inspect the quality of print, paper speed and feed, etc.

***Procedure to start the Recorder and Control Block Check Program***

1. To start the check program, press and hold the record key and NIBP INTERVAL key until the monitoring screen appears when you turn on the power. The SELF-TEST-PRO No.1 check program is ready for the execution.

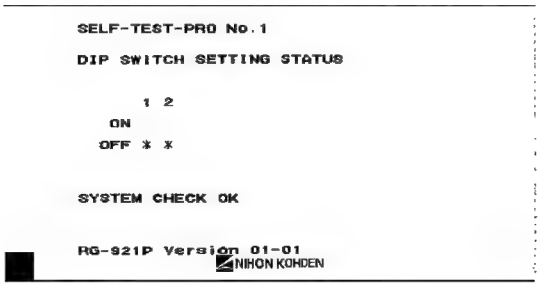
2. To select one of the three check programs for the recorder and control block checks, press the record key. Each time the record key is pressed, the check program changes as follows:
   SELF-TEST-PRO No. 1 → SELF-TEST-PRO No. 2 → SELF-TEST-PRO No. 3 → SELF-TEST-PRO No. 1

3. To start the selected check program, press the NIBP INTERVAL key.

4. To finish these checks, turn off the instrument.

### SELF-TEST-PRO No.1

This check program checks the peripheral circuits of the CPU for the recorder control block on the MAIN board, e.g. ROM, RAM and DIP switch setting status. The check result and recorder software version number are recorded on the paper as shown below approx. 30 seconds after the NIBP INTERVAL key is pressed. The recording starts soon after the black square on the paper is detected.




If an error is found, one of the following error codes appears on the paper.

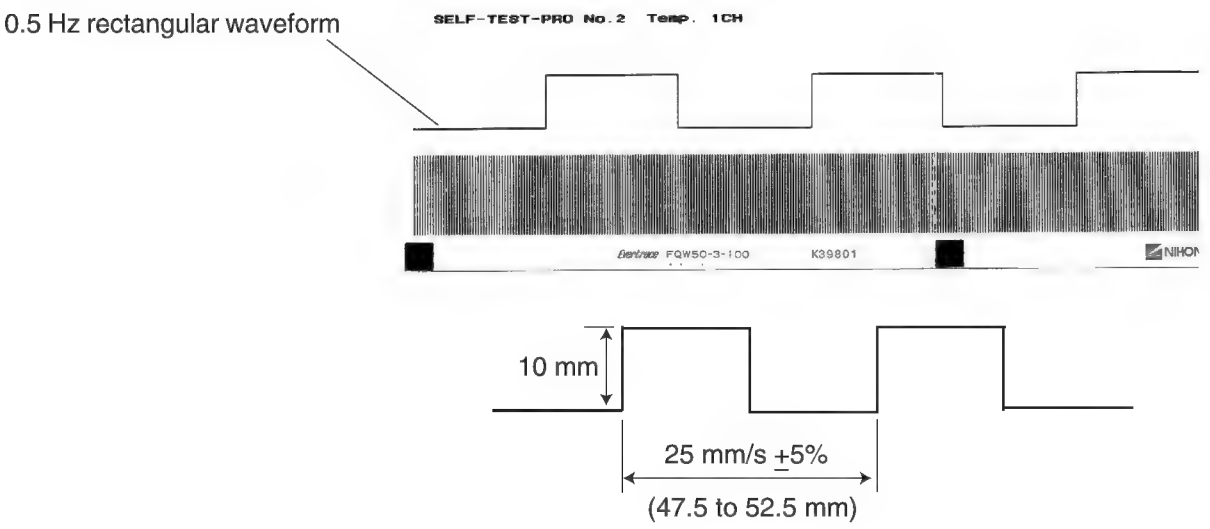
| Error Code | Description | Action |
|---|---|---|
| ROM | The ROM for the recorder control block on the MAIN board is faulty. | Replace the MAIN board with a new one. |
| RAM | The RAM for the recorder control block on the MAIN board is faulty. | Replace the MAIN board with a new one. |
| A/D | The common memory in the RACOON (ASIC) on the MAIN board is faulty. | Replace the MAIN board with a new one. |

### SELF-TEST-PRO No.2

This check program checks the paper speed, slip and snaking. A 0.5 Hz rectangular waveform and bar graph are recorded on the paper at 25 mm/s paper speed by pressing the NIBP INTERVAL key.

To stop the recording, press the NIBP INTERVAL key again.

25 mm/sec



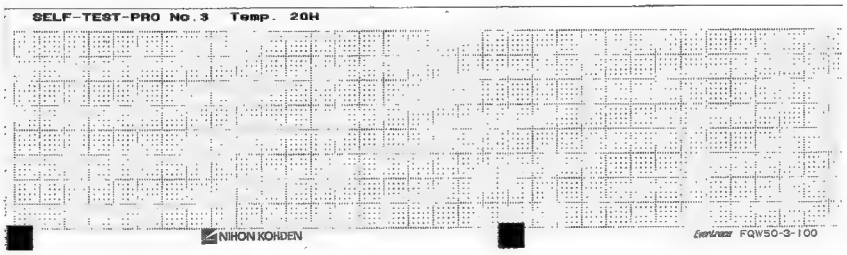
### SELF-TEST-PRO No.3

This check program checks the recording quality. There are the following three recording patterns for scale, character and thermal array head checks.
The recording pattern changes automatically after the NIBP INTERVAL key is pressed for the recording start. The recording starts soon after the black square on the paper is detected.

To stop the recording, press the NIBP INTERVAL key again.

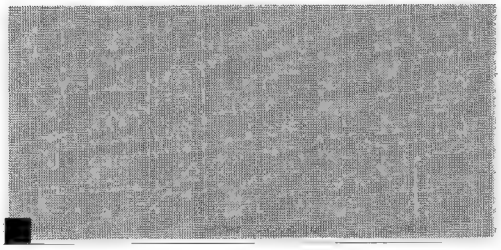
- Scale Check: Checks the circuit related to the scale recording in the recorder control block on the MAIN board. If the recording has something wrong, the MAIN board will be faulty.
- Character Check: Checks the circuit related to the character recording in the recorder control block on the MAIN board. If the recording has something wrong, the MAIN board will be faulty.
- Thermal Array Head Check: Checks the thermal array head condition and RAM for the storage of the data for the heat elements of the head. If there is a dot missing, faint dot or dark and faint dots mixed on the paper, check that the thermal array head is firmly attached and is not dirty. Replace the thermal array head with a new one if the head is cleaned but the problem still occurs. If the recording pattern has something wrong, the MAIN board will be faulty.

Scale Check



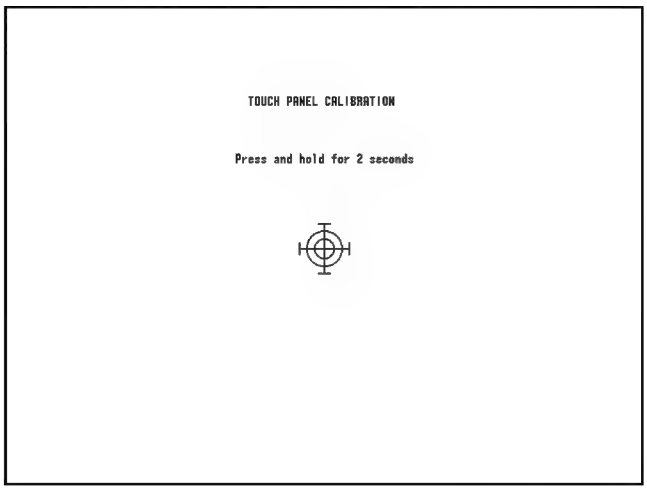

Character Check

Thermal Array Head Check



## Calibration of Touch Screen

When you replace the touch screen or MAIN board with a new one, the touch screen must be calibrated. Or, depending on the setting position, the effective point may slightly shift due to viewing angle. In that case, re-calibrate after the instrument is set up.




***Procedure to Start the Calibration of TOUCH PANEL***

1. To start the calibration of the TOUCH PANEL, call up the DIAGNOSTIC CHECK screen.

2. Press the MENU key to display the TOUCH PANEL CALIBRATION screen.

3. A target mark will be displayed from upper left corner to lower right corner (total of 9 points). Touch the center of the target mark until it moves to the next location.

4. After the calibration, you can confirm the recognized position. Touch anywhere on the screen and the target mark tracks your touching position.

5. To return to the DIAGNOSTIC CHECK screen, press the HOME key.

# *Section 4 Board/Unit Description*


MAIN Board ..... 4.1
DPU SP Board ..... 4.5
Mother PWR Board ..... 4.7
Mother CN Board ..... 4.7
ECG RESP1, ECG RESP2 and ECG RESP3 Boards ..... 4.8
NK $SpO_2$ Board and Nellcor $SpO_2$ Module ..... 4.11
    NK $SpO_2$ Board ..... 4.11
    Nellcor $SpO_2$ Module ..... 4.11
NIBP Measure Board and NIBP Safety Board ..... 4.12
MP1, MP2 and MP3 Boards ..... 4.13
TEMP Board ..... 4.15
Alarm SP Board ..... 4.15
WS Mother Board ..... 4.15
AG IF Board ..... 4.15
Power Supply Block ..... 4.16
LCD Unit ..... 4.16
Recorder Module ..... 4.17

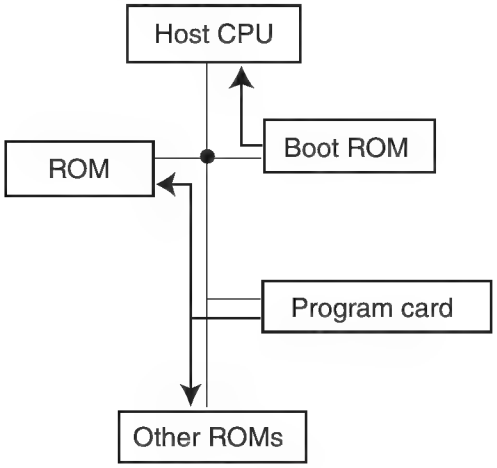
# MAIN Board

The MAIN board consists of system control block, display control block, recorder control block and power control block.

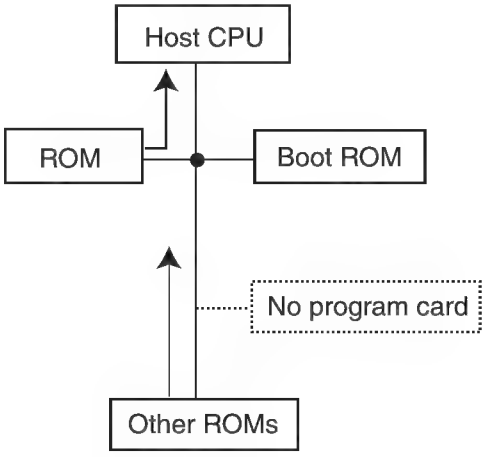
The system control block has the host CPU which gets the operation key status, displays the waveforms and numeric data and controls the recorder unit indirectly. The system program is stored in the 2 MB and 1 MB* flash EEPROM for host CPU, 128 KB Boot ROM in the system control block, 1 MB flash EEPROM for CPU in the recorder control block.
* Two 512 KB flash EEPROMs on the DPU SP board works for the host CPU system program.

When the instrument is turned on, the host CPU executes the program in the Boot ROM. According to the program, the host CPU checks if the program card is inserted into the slot on the MAIN board. When the host CPU recognizes that the correct program card is inserted, the host CPU writes the program from the card to each ROM. This is called Boot. Therefore, this Boot system allows you to upgrade the instrument without opening it. On the other hand, when the program card is not inserted into the slot, the host CPU executes the system program in the ROM in the system control block.

<When the program card is inserted>




<When the program card is not inserted>




a) System control block

The system control block consists of the host CPU, Boot ROM, flash EEPROM, system RAM*, backup RAM, real-time clock, two memory card interfaces, touch screen controller, audio circuit and main gate array.
* In addition to the 1 MB system RAM, 0.5 MB system RAM on the DPU SP board works for the host CPU.

An MC68SEC000 is used as the host CPU. The clock frequency is 20 MHz. The CPU controls the dedicated gate array, ASIC (Application Specific Integrated Circuit) ACORN, which controls the hard keys, function dials, touch screen, alarm indicator, QRS synchronous sound, alarm sound, real time clock, PCMCIA card interface, DPU communication, RS-232C communication and QM-421P ATA card interface.

The large capacity capacitor (Super capacitor) allows the 1 MB system RAM (SRAM) to back up the trendgraph, vital sign list, arrhythmia recall, monitoring conditions for each parameter and alarm settings for 30 minutes or more after the power is turned off. When the instrument is turned on after more than 30 minutes power off is past, the host CPU regards the backup data as damaged and initializes them.

The 32 KB backup RAM (non-volatile memory) permanently keeps the storage of the system setup conditions and alarm master settings after the power is turned off.

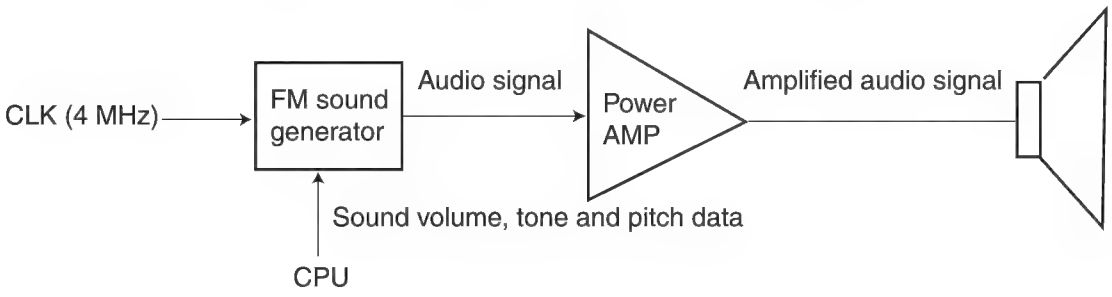
The lithium battery allows the real-time clock IC to update the date and time while the power is turned off. The lifetime of the lithium battery is approx. 6 years or more.

The two memory card interfaces select the bank at every 512 KB and can select the attribute memory or common memory from the memory card.

The host CPU periodically reads the status of all the hard keys on the instrument through the ACORN and executes the process according to the key status. The status of the Record key and NIBP INTERVAL key are also read by the local CPU in the recorder control block. This is used for the recorder and recorder control block checks in the monitoring mode. Refer to Section 3 DIAGNOSTIC CHECK.

The touch screen is controlled by a dedicated microchip controller. When you touch a point on the screen, the microchip controller sends the touch position data to the host CPU through the ACORN with serial data communication.

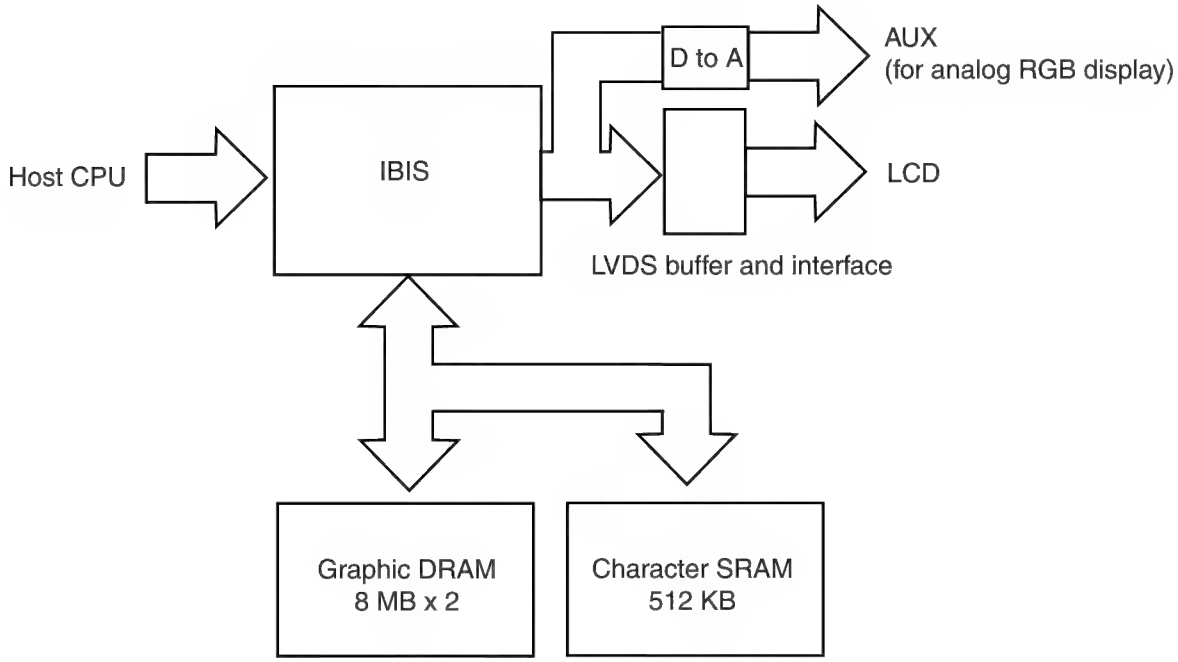
The audio circuit uses an FM sound generator (sound source IC) so that the QRS sound, alarm sound and key sound are generated at the same time. The sound volume control data as well as the tone and pitch data is written to the FM sound generator by the host CPU. The audio output signal from the FM sound generator is amplified by the audio power amplifier so that the speaker sounds.



b) Display control block

The display control block consists of the dedicated graphic ASIC IBIS for entire display control, two 8 MB DRAMs for display of waveform and graphic data, 512 KB high-speed SRAM for display of alphanumeric data and display interfaces for the LCD and an external RGB monitor.

When the IBIS receives a display control command from the host CPU, the IBIS accesses these memories to get the display data and arranges the display data for RGB outputs. There are two RGB outputs. One is RGB output for the LCD through the LVDS (Low Voltage Differential Signaling) interface. The other one is RGB output for a locally available RGB monitor. The LVDS interface which is different from a CMOS or TTL display interface uses approx. 0.3 V peak-to-peak differential signal in serial data communication.

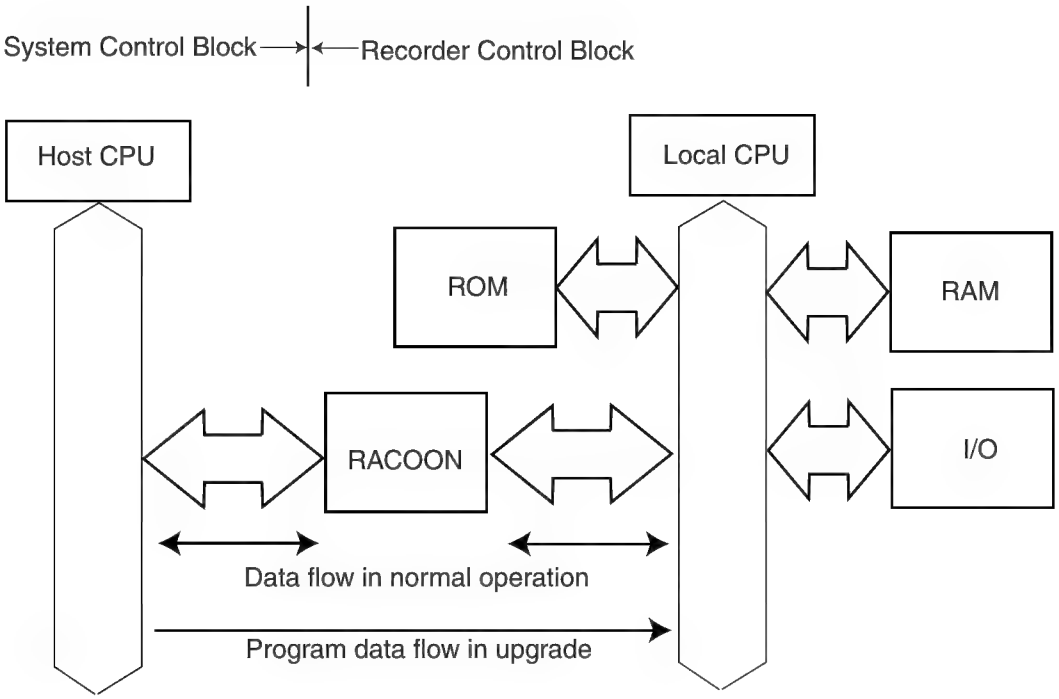



c) Recorder control block

The recorder control block consists of the local CPU (16 MHz MC68SEC000), 1 MB system ROM for program storage, 512 KB system RAM for the local CPU working area and the dedicated recorder control ASIC RACOON.

The local CPU accesses the ROM or RAM through the RACOON. When the RACOON receives a recorder control command from the local CPU, the RACOON accesses the RAM to get the recording data and controls all the recording functions such as the motor and thermal array head in the recorder unit.

When the instrument is upgraded, the local bus in the recorder control block is directly connected to the system bus (in the system control block) and the 1 MB system ROM takes a part of the memory for the upgrade program.



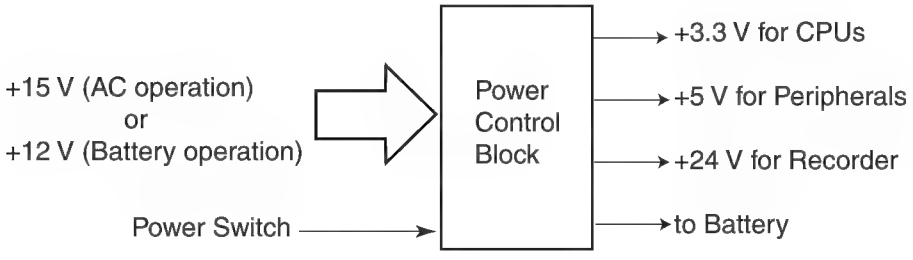

d) Power control block

The power control block consists of the power supply microchip controller, DC/DC converters, buzzer and its driver and battery interface.

+15 V from the power supply unit or +12 V from the rechargeable battery is converted to +3.3 V, +5 V and +24 V supply voltages by the DC to DC converters and power supply microchip controller.

When the line voltage is supplied to the instrument and the battery is inserted into the instrument, the power supply microchip controller charges the battery with approx. 190 mA (normal charge) for 15 hours. After the 15 hours, the controller uses trickle charging to charges the battery with approx. 60 mA so that the fully charged battery condition is maintained.

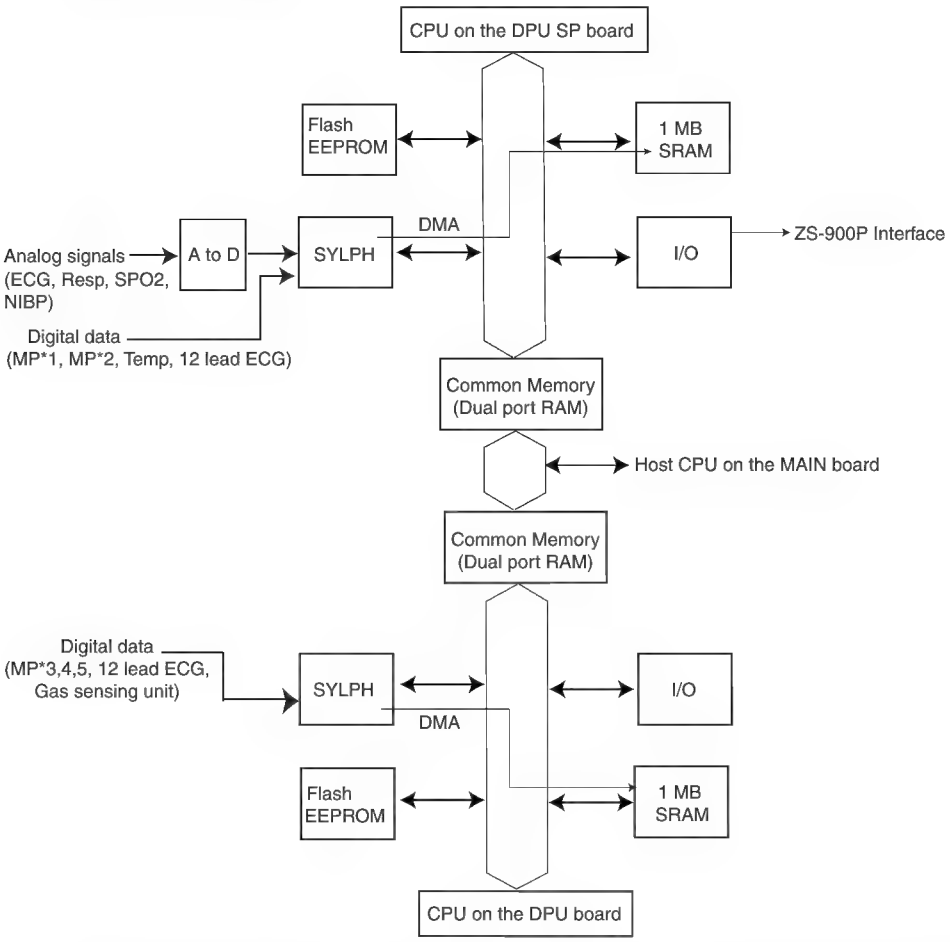
If the normal or trickle charging is interrupted for one hour or less by power failure or disconnection of the power cord and the battery is not removed from the instrument, the controller memorizes how many hours the battery is charged before the interruption. After it is removed, the controller charges the battery under the memorized condition to protect the battery against excessive charge.



# DPU SP Board

The DPU SP board receives the vital sign information (analog signals and digital data) from the input boards in the input block.
The DPU SP board has the two same circuits which consist of the CPU, ROM, RAM, ASIC (SYLPH), and I/O as shown below.

Each CPU on the DPU SP board executes the primary processing of the vital sign information.




All the analog signals for the vital signs are multiplexed and converted to the digital data along the multiplexing timing. The DMA (Direct Memory Access) assigned each vital sign data into the individually specified area of the 1 MB SRAM on the DPU SP board. The digital data converted from the vital sign analog signal at one of the boards in the input block is sent to the bus on the DPU SP board with serial data communication. This digital data is also assigned into the individually specified area of the 1 MB SRAM by the DMA.

MC68SEC000 is used as the CPU. The clock frequency is 20 MHz. The CPU controls the dedicated gate array ASIC (SYLPH) which is used as the data process controller to control the A to D converter and DMA, and to mediate the accesses to the common memory (dual port RAM) between the host CPU on the MAIN board and CPU on the DPU board. The SYLPH has an I/O port.

Flash EEPROM is used for the program storage. This ROM can be programmed by the host CPU at the Boot. Refer to “MAIN Board” section.

ZS-900P interface and ECG/BP output circuits are provided on the board. These circuits send out the analog signals with almost no delay. Especially, the ECG analog signal amplified on the ECG/RESP boards directly goes to the ECG/BP output socket through the isolation interface on this board.
The BP analog signal amplified on the MPI board goes to the A to D converter of the H8 CPU on the MP2 board.
The BP pulse width modulation signal from the H8 CPU goes to the ECG/BP output socket through the isolation interface on this board. These analog signal outputs do not require any process with CPUs on the MAIN board and DPU SP board.

## Mother PWR Board

The mother PWR board isolates the input boards such as ECG RESP1 to 3 boards, $SpO_2$ board and MP1 to 3 boards from the ground. The mother PWR board supplies the isolated power to each input board. The mother PWR board sends the vital sign signals from the input boards to the DPU SP board. The mother PWR board sends the control signals from the DPU SP board to the input boards.

For ECG related signals, the ECG RESP1, ECG RESP2 and ECG RESP3 boards are communicated through the mother PWR board. The ECG waveforms (for arrhythmia detection and screen display) and respiration waveform are analog signals and multiplexed on the mother PWR board and sent to the DPU board. 12 lead ECG signals digitized on the ECG RESP3 board are sent to the DPU SP board.

The status signal of NIBP cuff size for adult/child or neonate is also sent to the DPU SP board through the isolated ECG status line.
The $SpO_2$ probe output voltages (analog signals) are multiplexed at 2 ms interval on the SpO2 board. The multiplexed analog signals are sent to the DPU SP board through the isolated line on the mother PWR board.

The vital sign input signals on the MP1 to 3 boards are digitized by the A to D converter which is controlled by the CPU on the MP2 board. The digital data is sent to the DPU SP board through the mother PWR board.

## Mother CN Board

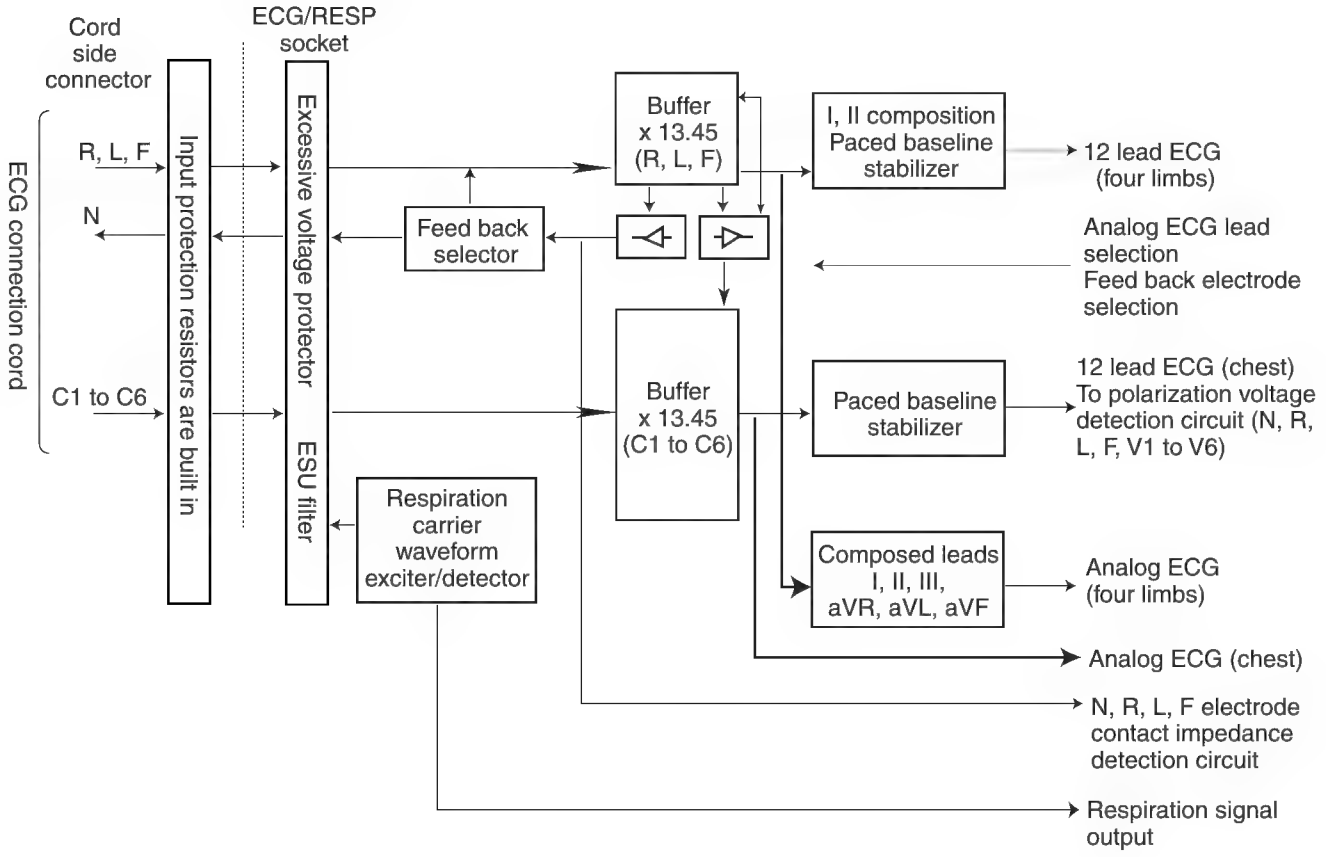
The mother PWR board and input boards such as the ECG RESP1 to 3, SpO2 and MP1 to 3 boards are connected to this mother CN board. All the signals from the input boards are sent to the mother PWR board through the mother CN board.

# ECG RESP1, ECG RESP2 and ECG RESP3 Boards

These three boards process the ECG and impedance method respiration signals.

There are two ECG processing circuits on the ECG RESP1 board. One is ECG analog signals for arrhythmia analysis and screen display which are selectable with the lead select function. The other one is digital ECG data for 12 lead ECG display and analysis which is digitized by the A to D converter in the CPU on the ECG RESP3 board.

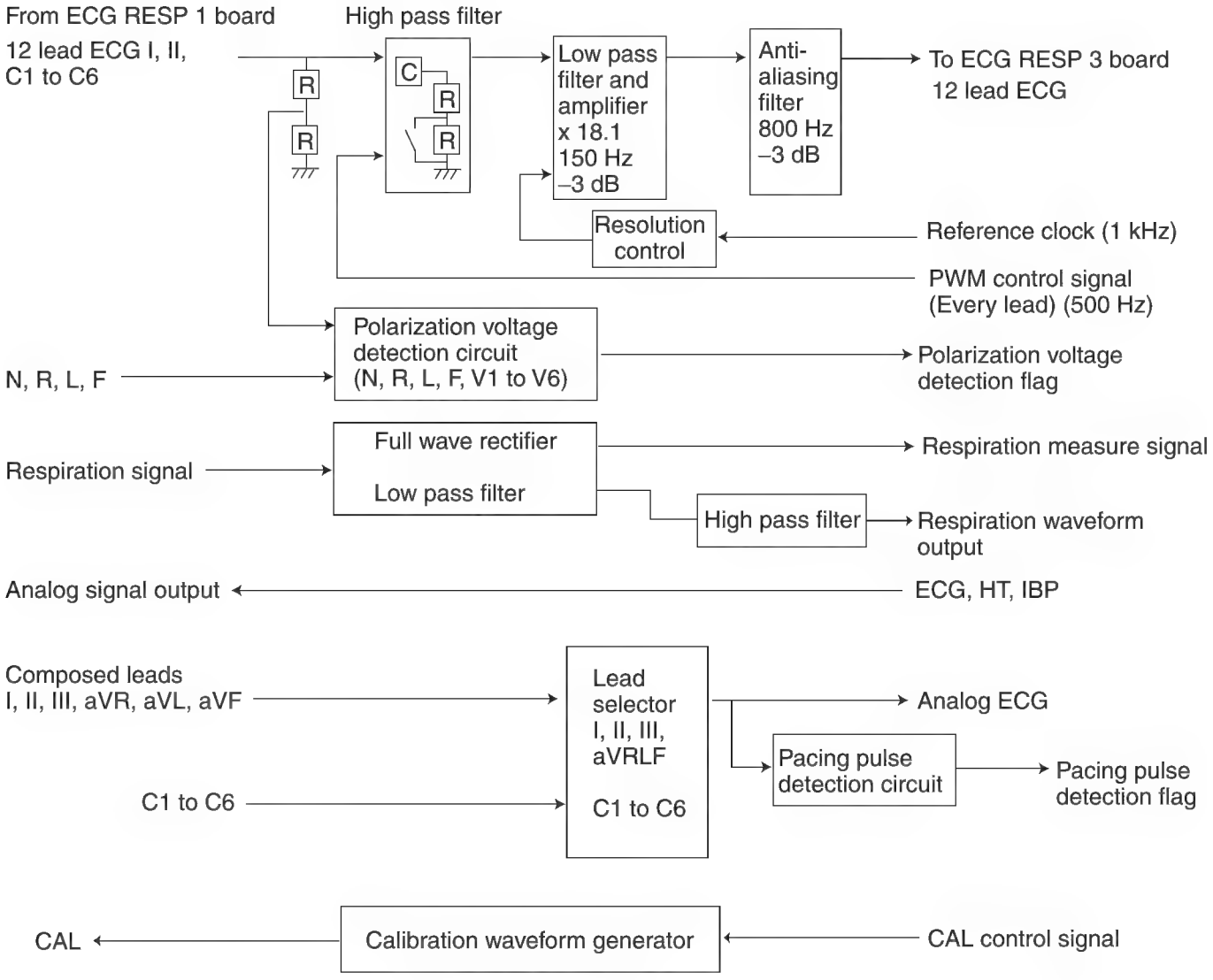
The ECG RESP1 board has the impedance method respiration exciter and detection circuits. These circuits outputs the voltage (respiration signal) which varies proportionally to the impedance including the electrode contact impedance between the two electrodes on a patient's chest.


Cord side connector
ECG/RESP socket
ECG connection cord
R, L, F
N
C1 to C6
Input protection resistors are built in
Excessive voltage protector
ESU filter
Feed back selector
Buffer x 13.45 (R, L, F)
Buffer x 13.45 (C1 to C6)
I, II composition Paced baseline stabilizer
Paced baseline stabilizer
Composed leads I, II, III, aVR, aVL, aVF
Respiration carrier waveform exciter/detector
12 lead ECG (four limbs)
Analog ECG lead selection
Feed back electrode selection
12 lead ECG (chest)
To polarization voltage detection circuit (N, R, L, F, V1 to V6)
Analog ECG (four limbs)
Analog ECG (chest)
N, R, L, F electrode contact impedance detection circuit
Respiration signal output

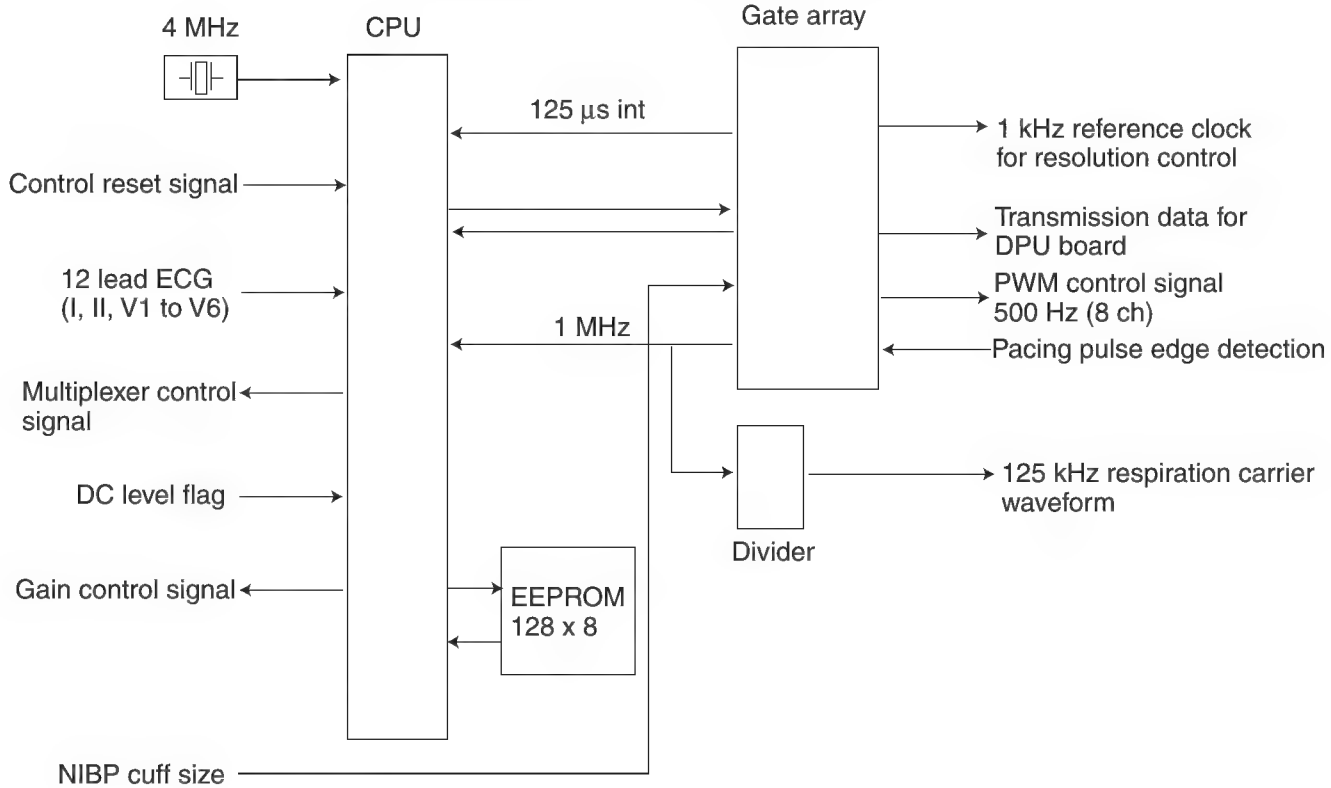
The ECG RESP2 board has the high-pass filter (for 12 lead ECG), low-pass filter (for 12 lead ECG) and polarization voltage detection circuit.

The lead for arrhythmia analysis is selected on this board. The ECG analog signal on the selected lead for arrhythmia analysis goes to the ECG RESP3 board.

Since the respiration signal is proportional to the impedance between the two electrodes, the respiration circuit sends a measurement status signal to the CPU on the ECG RESP3 board according to the impedance level. The respiration circuit has the high-pass filter so that the respiration waveform is obtained.



The ECG RESP3 board has the high-pass filter (for the selected lead ECG analog signal at the amplifier final stage), low-pass filter (for the selected lead ECG analog signal at the amplifier final stage) and A to D converter (for 12 lead ECG) in the CPU for primary data processing. There is a supply voltage control circuit to adjust the 12 lead ECG sensitivity. The NIBP cuff size (adult/child or neonate) sensor (hall element) is provided on this board. The status signal from the sensor goes to the gate array on this board and is transferred to the DPU board through the motherboard.

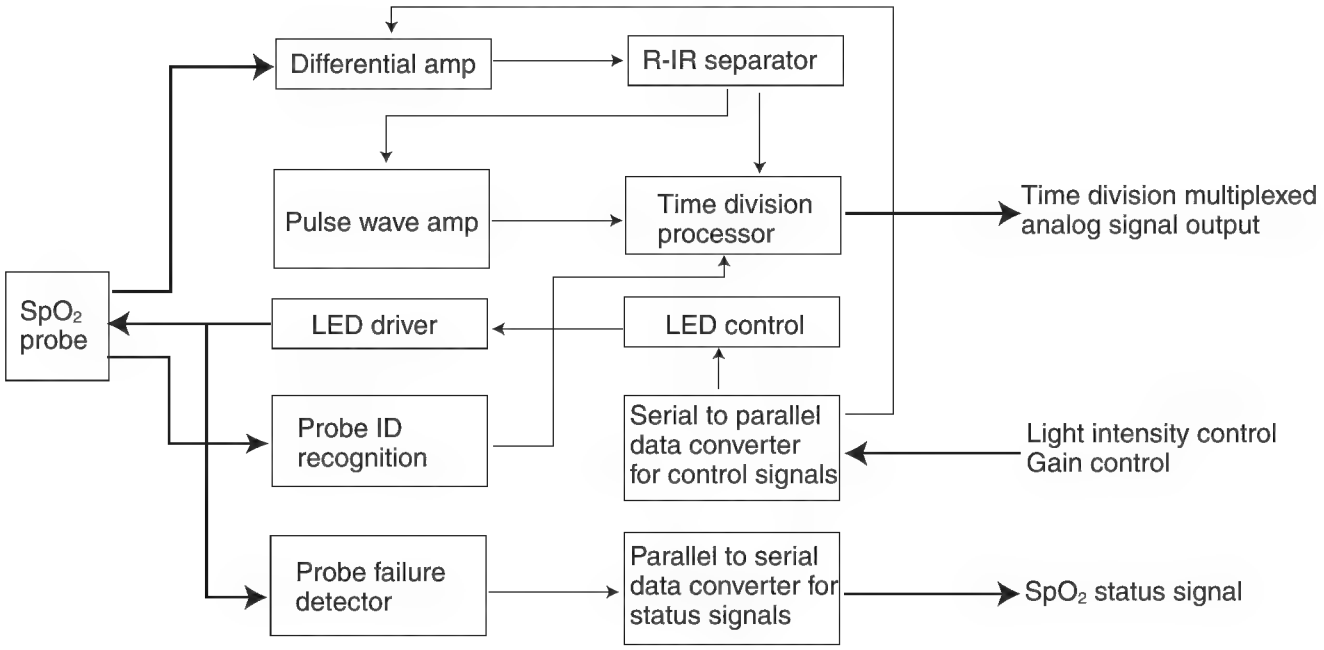


# NK $SpO_2$ Board and Nellcor $SpO_2$ Module

## NK $SpO_2$ Board

This board consists of the following blocks.

- Differential amplifier block for the electrical signals detected by the photodiode when the red LED and infrared LED in the $SpO_2$ probe alternatively transmits the lights to the subject
- Red and infrared related signals separator block
- Pulse wave amplifier block
- Time division multiplexed analog signal block
- LED drive current control block
- Probe ID recognition block
- Probe failure detection block




## Nellcor $SpO_2$ Module

The module covers all the abovementioned blocks in the NK $SpO_2$ board. The module sends the $SpO_2$ data and status data to the DPU board through the motherboard by serial data communication.

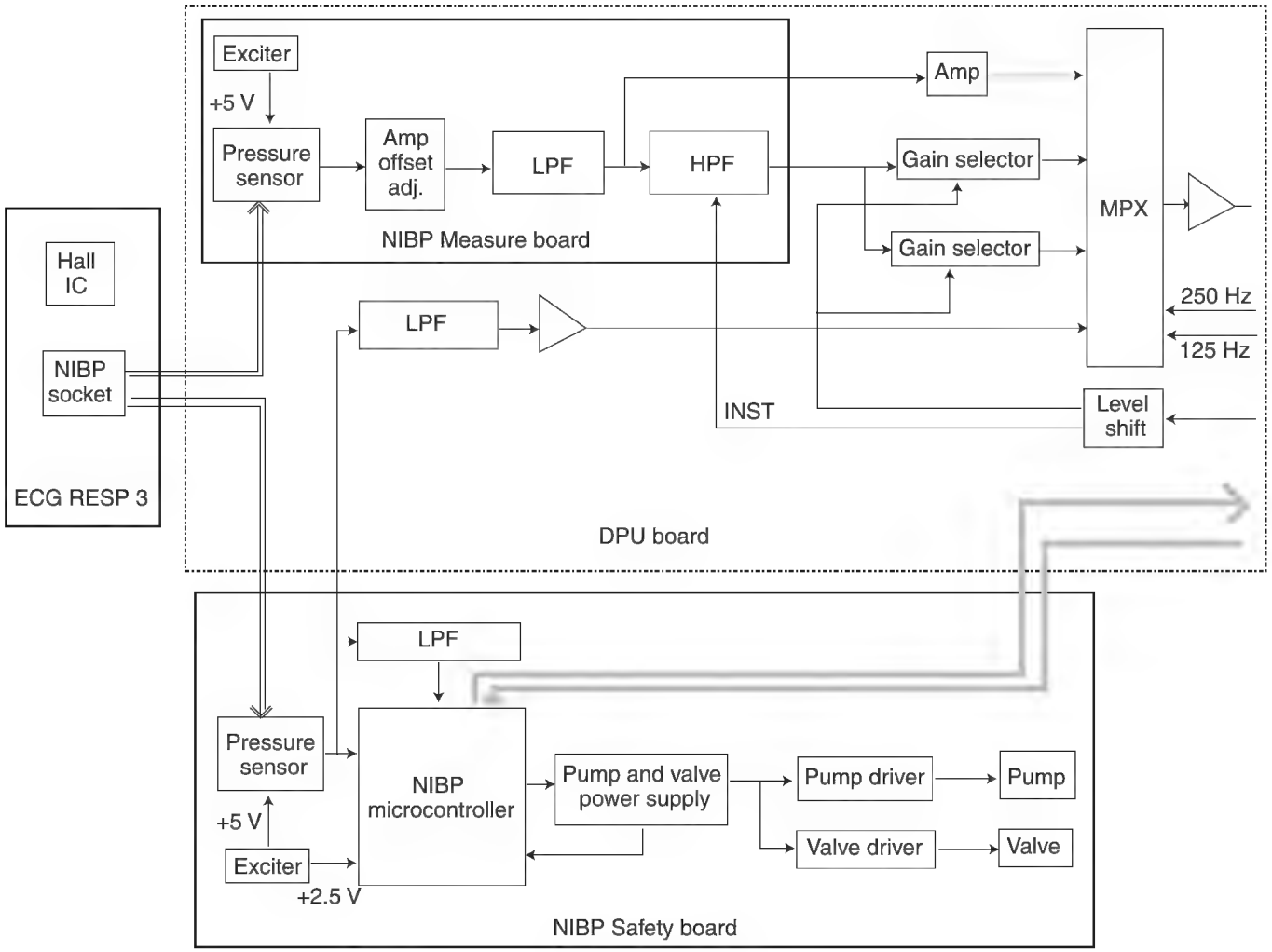
# NIBP Measure Board and NIBP Safety Board

The NIBP Measure board has the pressure sensor for NIBP measurement to detect the cuff pressure and convert it to an electrical signal.

The NIBP Safety board consists of a microcontroller for safety control, pressure sensor, solenoid valve, pump and power supply cut-off circuit for the valve and pump. This board as well as the NIBP Measure board individually monitors the cuff pressure. If a wrong operation such as excessive cuff inflation caused by the NIBP Measure board occurs, the NIBP Safety board provides the multi safety functions so that the patient is protected from the wrong operation.

When the microcontroller works for the safety, the drive voltage is not supplied to the pump and valve for 30 seconds. This prevents the cuff from inflating during this period.

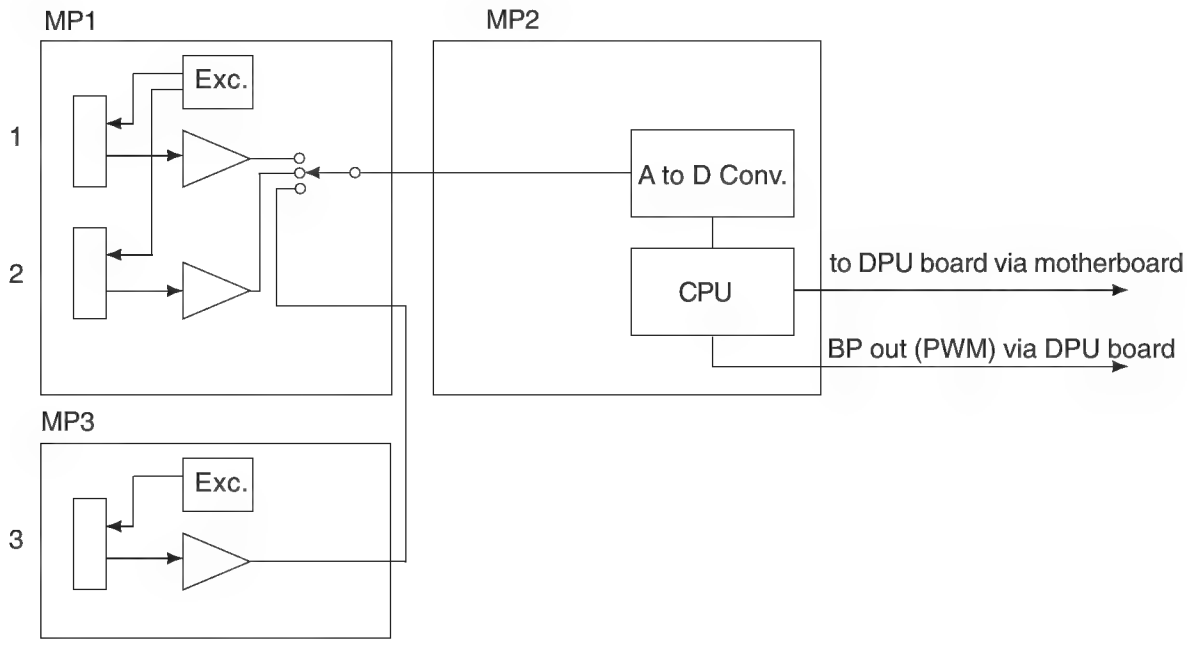
Since the measurement data from the NIBP Measure board and NIBP Safety board are compared and safety circuit operation is always monitored, the "Safety Circuit Error" status message immediately appears on the screen if the NIBP measurement has something wrong.



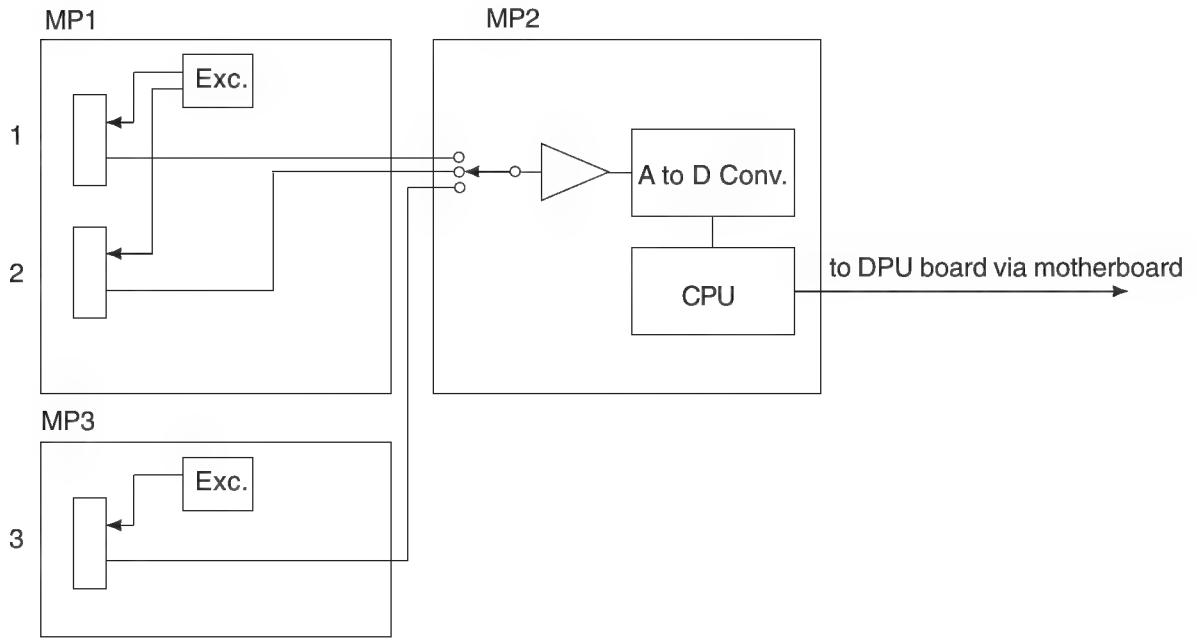
# MP1, MP2 and MP3 Boards

The MP1 and MP3 boards have universal input sockets. The MP1 board has two input sockets but the MP3 board has one or no socket depending on the instrument model number.

The MP1 board and the one input socket MP3 board have an input protection circuit, invasive blood pressure amplifier, thermistor probe method respiration input preamplifier, each transducer/sensor internal wire cut detection circuit, exciter circuit and its power supply circuit, excessive current protection circuit, communication circuit for the EEPROM in the connection cord connector and asynchronous communication circuit for $CO_2$ sensor.



The MP2 board acquires the analog signals from the MP1 and MP3 boards and has the preamplifier for CO, temperatures and $FiO_2$ input signals. These analog signals are converted to digital signals on the MP2 board. The communication control circuits for the EEPROM in the connection cord connector and $CO_2$ sensor are also on this board.



## TEMP Board

The TEMP board is based on the MP3 board which has a multi-parameter socket. But the TEMP board which is dedicated to temperature measurement only has two jacks for temperature probe connection instead of the multi-parameter socket.

## Alarm SP Board

The alarm SP board has the red, yellow and green LEDs to indicate the alarm and heart beat synchronization.

## WS Mother Board

The WS mother board is connected between the MAIN board and WS-510P recorder module (option). When the optional recorder module is built in the instrument, the recorder connection status signal is generated on this board.

## AG IF Board

The AG IF board works for data communication protocol interface between the DPU SP board and AION unit of the gas sensing unit. To convert the communication protocol, the AG IF board has an H8 CPU. The AG IF board generates the supply voltage for the AION unit from the voltage supplied to this board.

## Power Supply Block

The power supply block consists of the power supply unit (+15 V DC output), fuse holder built-in type AC inlet socket, ground terminal and line frequency detection coil. Refer to Section 8 REPLACEABLE PARTS LIST.

This power supply unit same as in the BSM-1100 series, BSM-2300 series, BSM-4100 series, OPV-1500 and WEP-4200 series is used.

## LCD Unit

12.1 inch TFT color LCD which has 800 dots × 600 dots (SVGA) is used as the display. This LCD unit can display maximum 512 colors. 12 colors can be assigned for waveforms and each vital sign parameter by the user.

Since the LCD unit is covered with a polarization filter which is weak against impact and pressure, it requires your attention during service.

The LCD unit has two cold cathode tubes to backlight the LCD. The high voltage for the two tubes is supplied from the inverter board.

It takes approx. 25,000 hours (about 2 years and 10 months) for the brightness to decrease from maximum to half brightness (lifetime of the backlight) if the two tubes at the maximum brightness work in continuous operation. Therefore, the tube may need to be replaced after 25,000 hours of use.

# Recorder Module (Option)

The recorder module consists of the paper drive unit and WS IF board. The paper drive consists of the thermal array head, paper drive motor, gears, photo sensor, sensor board, sensor control board and chassis.

The RACOON (ASIC) on the MAIN board allows the recorder unit to record the 3 channel waveforms, vital sign list and trendgraph.

Since the thick membrane type thermal array head is used, the adjustment of the supply voltage to the head is not required. The lifetime of the heating elements on the head is 100 million heating times.

A stepping pulse motor is used as the paper drive motor. The lifetime of the motor is approx. 3000 hours continuous operation.

When a set of the LED and photo sensor on the sensor board is replaced with a new one, the sensor control VR must be adjusted. See Section 7 ADJUSTMENT.

# *Section 5 Disassembly and Assembly*


Before you Begin ..... 5.1

Opening the Instrument ..... 5.2
- Removing the Recorder Unit or Blank Panel ..... 5.2
- Removing the Rear Chassis ..... 5.2
- Removing the NIBP Safety Board ..... 5.4
- Removing the Vital Sign Input Block ..... 5.4
- Removing the Mother PWR Board ..... 5.5
- Removing the Mother CN Board and Input Boards ..... 5.6
- Removing the NIBP Measure Board and DPU SP Board ..... 5.7
- Removing the MAIN Board ..... 5.9

Replacing the Touch Screen ..... 5.10

Replacing the Backlight Lamps ..... 5.12

Replacing the Lithium Battery ..... 5.15

Replacing the Gas Sensing Unit and AG IF Board (BSM-5135/5136 only) ..... 5.16
- Removing the AG IF Board ..... 5.16
- Replacing the Dryline Receptacle ..... 5.17

Replacing the Rechargeable Battery (Option) ..... 5.20

The procedure in this section tell how to remove, replace and install the major components in the instrument.

## Before you Begin

Removing, replacing and installing the major components should be done by qualified service personnel.

**WARNING**

**To avoid the possibility of injury to yourself or damage to the instrument, do not install or remove any component or change the internal switch settings while the power is on. After the power is off, wait a few minutes before disassembling the instrument.**

**CAUTION**

**• Fuses cut off the power when an abnormality occurs in the instrument. Eliminate the malfunction before replacing the fuse. Use the correct fuse only. The fuse rating is shown on the holder.**
**• To avoid accidental discharge of static electricity, which could damage the instrument components, use a wrist ground strap when installing or removing any component.**

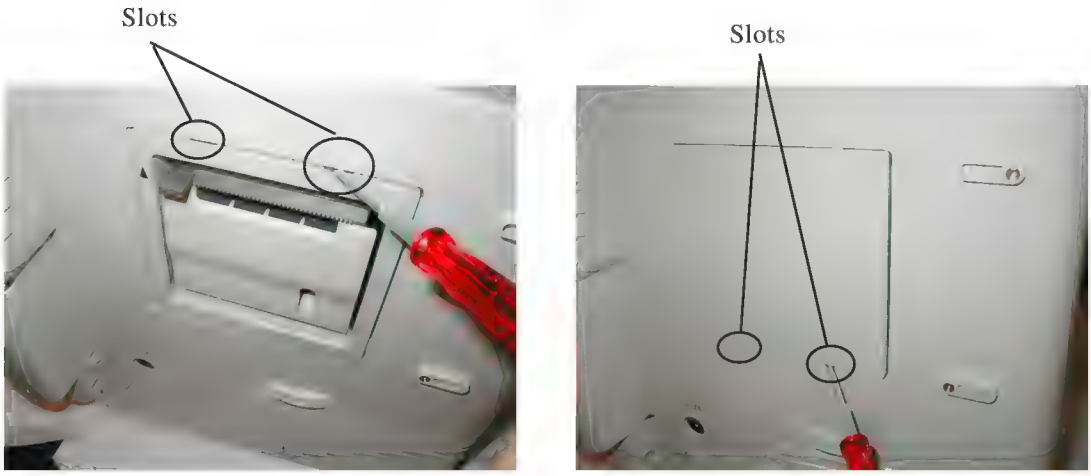
**Required Tools**

Anti-static bench mat
Anti-static wrist strap
Flat-blade screwdriver (insulated type)
Small flat-blade screwdriver
Phillips screwdriver (insulated type)
Hex socket driver
Tweezers
Nippers
Cable tie

# Opening the Instrument

## Removing the Recorder Unit or Blank Panel

Pull the paper magazine release lever upward and open the magazine door. Insert a small flat-blade screwdriver into one of the two slot spaces as shown below and slightly pull the magazine door (or blank panel) so thatthe inside hook is released. Insert the screwdriver into another slot space and pull the magazine door (or blank panel) so that the inside hook is released. Completely remove the recorder unit (or blank panel) from the instrument.



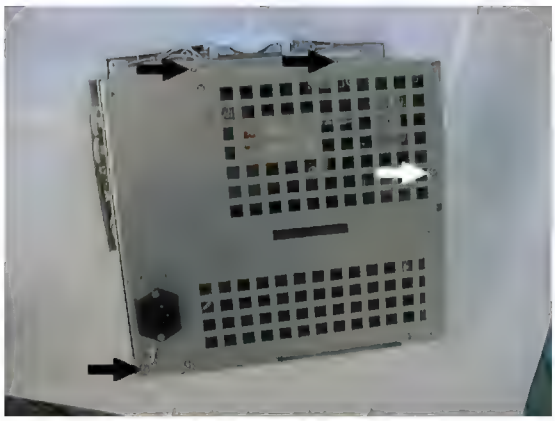

## Removing the Rear Chassis

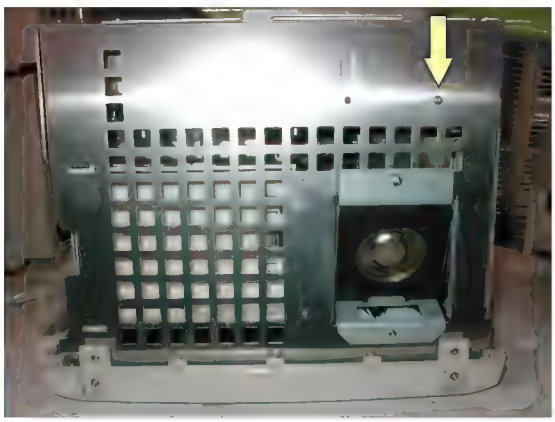
1. Cover the table with a soft cloth to protect the display from damage. Lay down the instrument with the front panel on the table. Remove the 2 screws from the bottom of the instrument as shown below.

2. Remove the 5 screws from the instrument as shown below.

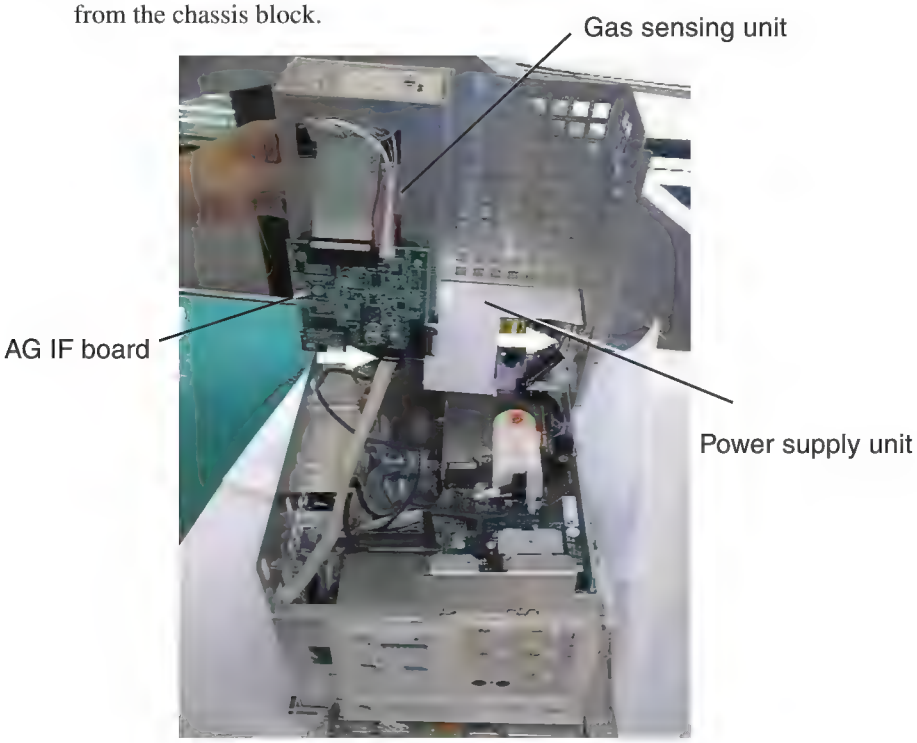
3. Remove the rear enclosure from the instrument.

4. Remove the 5 screws which secure the rear chassis to the chassis block as shown below.



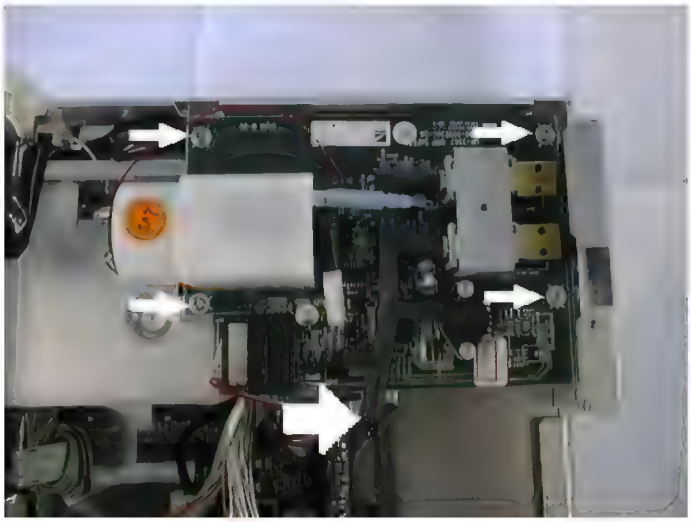


5. Disconnect the 2 cables from the rear chassis and separate the rear chassis including the power supply unit and (gas sensing unit and AG IF board) from the chassis block.



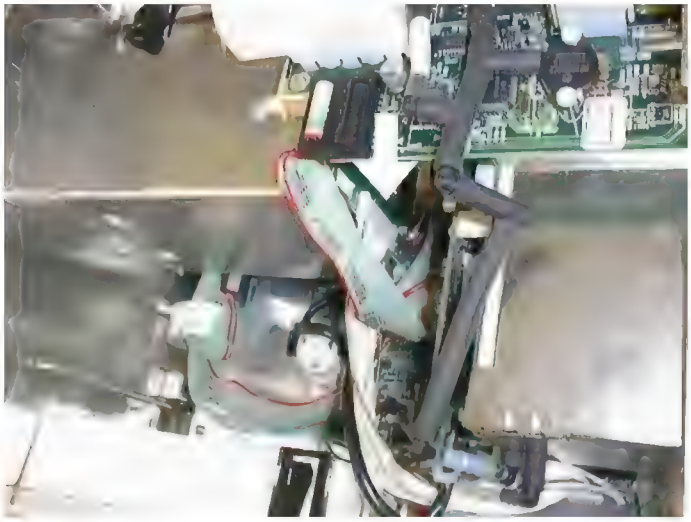
## Removing the NIBP Safety Board

Disconnect the air hose from the joint and remove the 4 screws which secure the NIBP safety board to the chassis block as shown below. Remove the board from the chassis block.

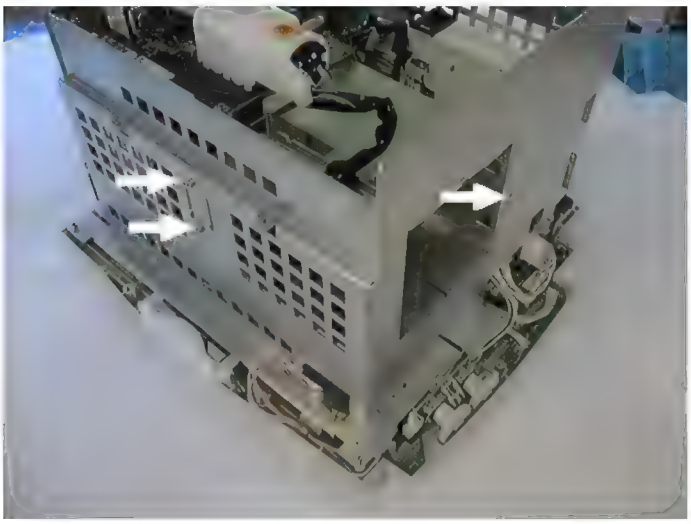


## Removing the Vital Sign Input Block

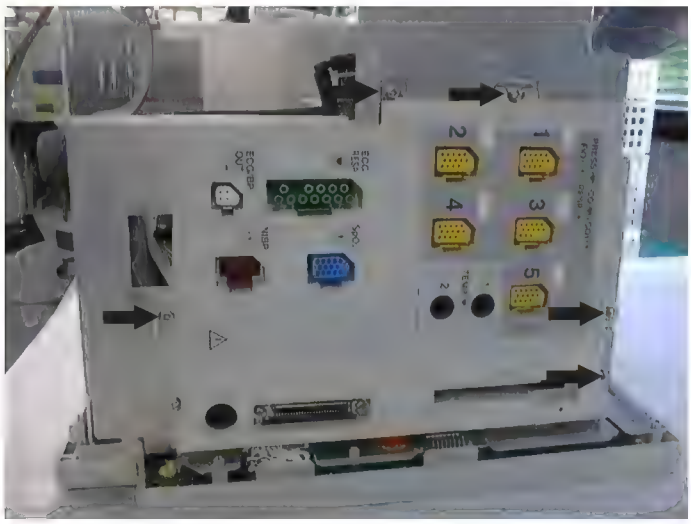
1. Disconnect the cable between the NIBP Safety board and DPU SP board as shown below.



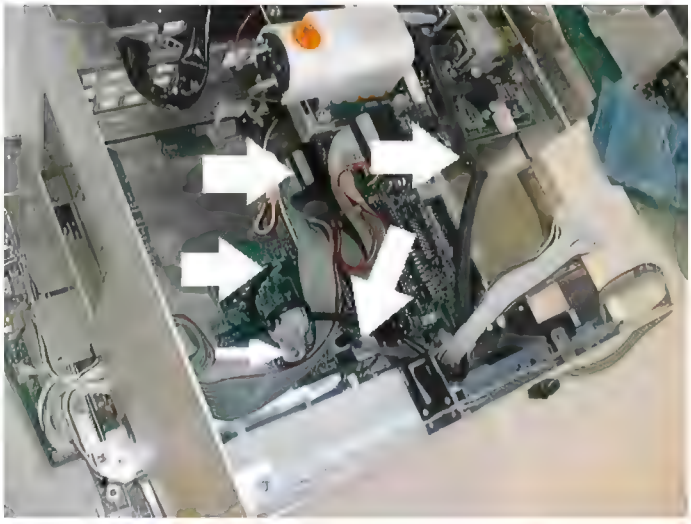
2. Remove the 3 screws (2 pan head screws and F3 x 8 screw) which secure the recorder chassis to the chassis block as shown below. Remove the recorder chassis from the chassis block.



3. Remove the 5 screws (3 pan head screws and 2 bind head screws) which secure the input block to the chassis block as shown below.

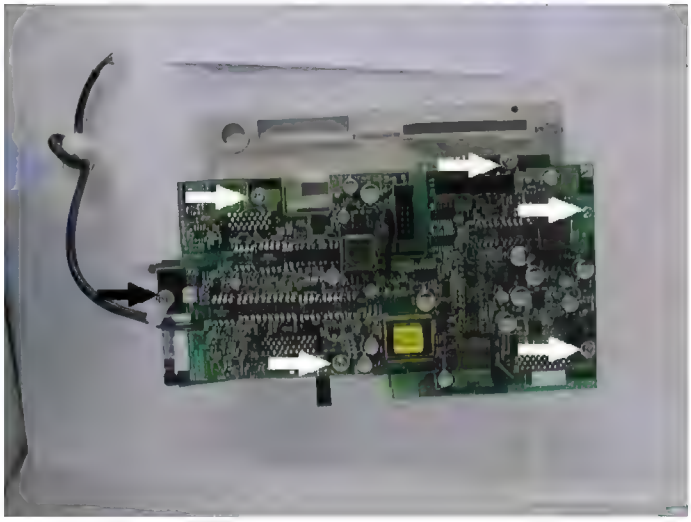


4. Disconnect the 2 air hoses and 2 cables as shown with large arrows in the following picture and remove the bind head screw as shown with a small arrow in the picture. Remove the input block from the chassis block by sliding the input block outward.



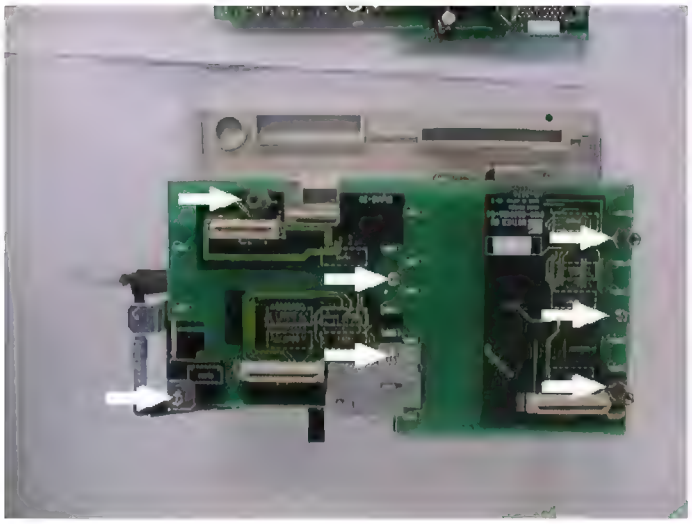
## Removing the Mother PWR Board

Remove the 6 screws (5 pan head screws and bind head screw) which secure the mother PWR board to the input block as shown below. Remove the board from the input block.

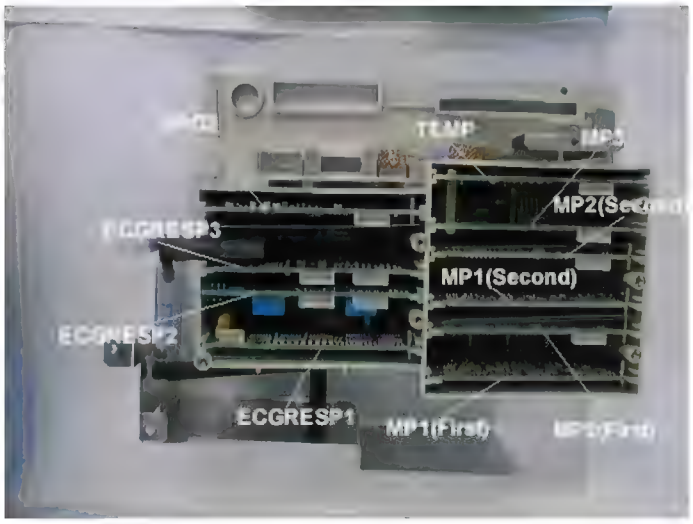


## Removing the Mother CN Board and Input Boards

1. Remove the 4 screws and 3 spacers which secure the mother CN board to the input block. Remove the board from the input block.

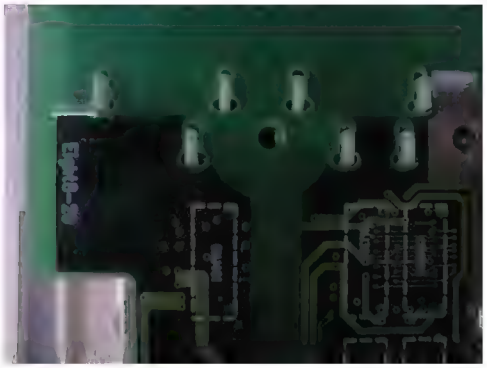


2. All the input boards are set in the input block as shown below. You can remove the input boards in pairs. The two boards can be separated by removing a screw from the two boards.

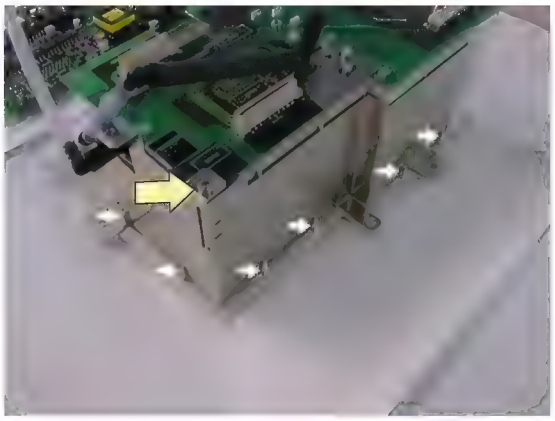



### NOTE in Assembling the Instrument

- **To assemble the mother CN board and all the input boards, align the projection bottom edge of each input board with the bottom edge of the inverted T shape holes on the mother CN board (as shown below) so that both side connectors on each input board and the mother CN board can correctly catch each other. Then, depress the area of the connectors, which are indicated with dashed squares on the board.**

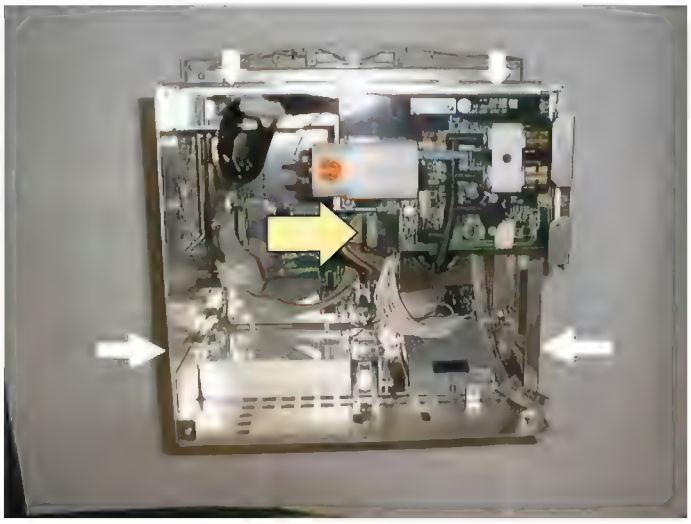


- **Insert each slot of the metal plate into the projection (shown with small arrows in the following picture) and attah the metal plate to the input block with the screw shown with the large arrow.**

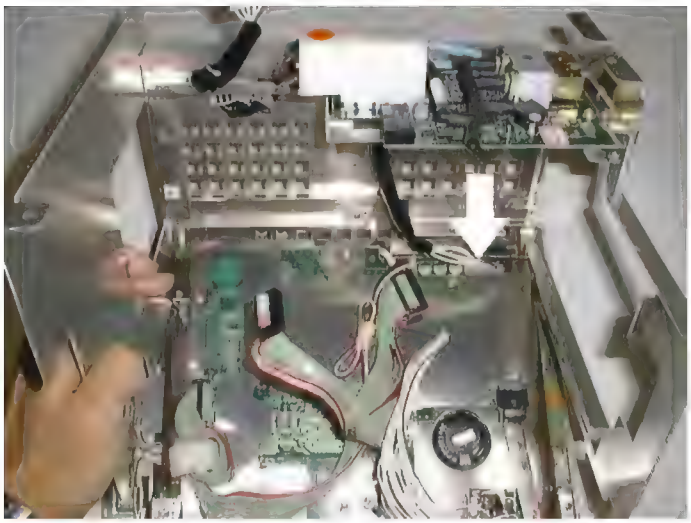


## Removing the NIBP Measure Board and DPU SP Board

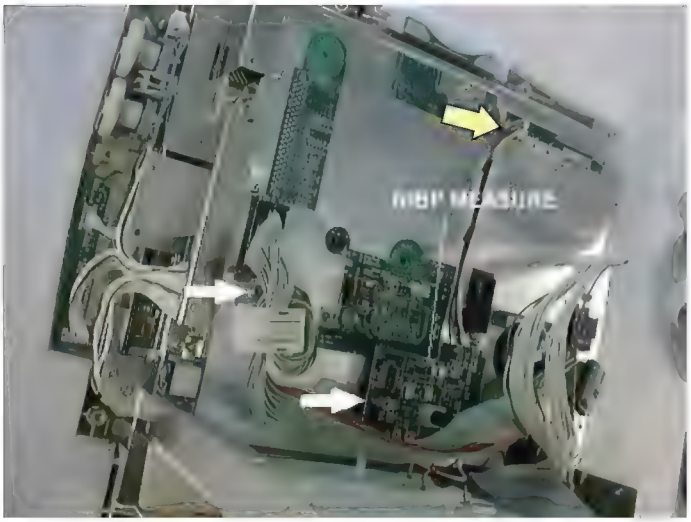
1. After removing the input block in step 11, remove the 4 screws (shown with small arrows in the following picture) and disconnect the cable from the NIBP Safety board as shown with a large arrow.



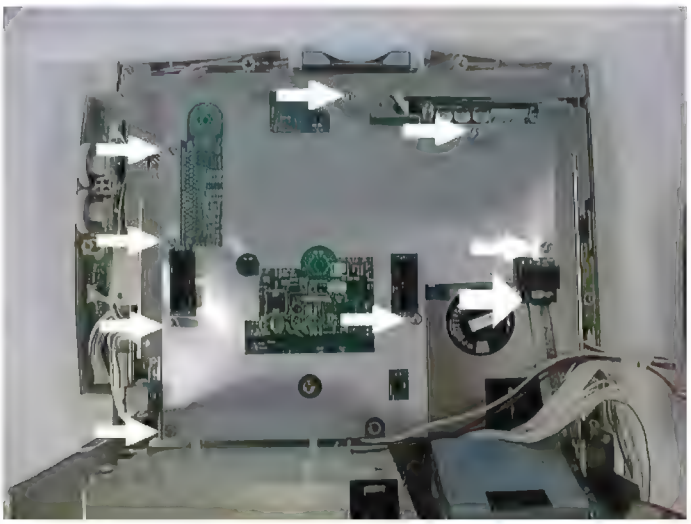
2. Lift the main chassis including the NIBP Safety board until the cable (shown with the large arrow in the following picture) can be disconnected. Disconnect the cable from the NIBP Safety board. Remove the main chassis from the block which includes the NIBP Measure board, DPU SP board, MAIN board and LCD unit.



3. Remove the spacer which secures the NIBP Measure board to the DPU SP board. Remove the NIBP Measure board from the DPU SP board. Remove the bind head screw which secures the ferrite core to the shielding cover and disconnect the flat cable and ferrite core from the DPU SP board. Disconnect the cable for rechargeable battery from the MAIN board.

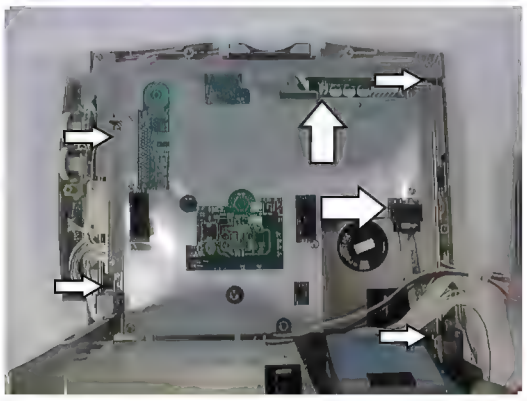


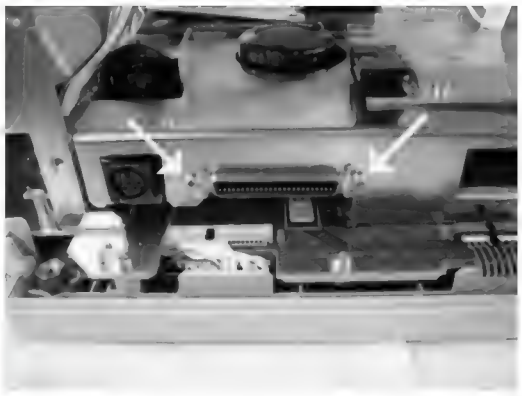
4. Remove the 7 screws and spacer which secure the shielding cover to the DPU SP board as shown with small arrows in the following picture. Disconnect the connection cable from the DPU SP board when the instrument has the gas sensing unit and AG IF board. Remove the shielding cover from the DPU SP board. Remove the DPU SP board from the MAIN board.



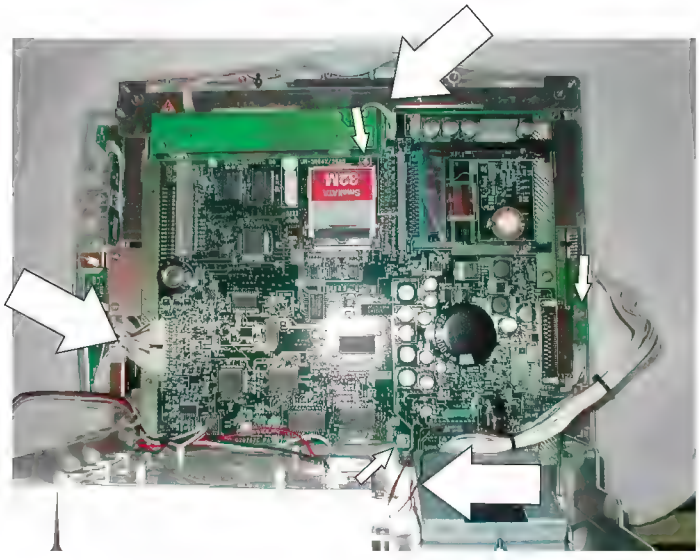
## Removing the MAIN Board

1. After removing the main chassis in step 15, remove the 4 screws (shown with small arrows in the following left picture) and 2 small screws (shown with arrows in the following right picture) which secure the shielding cover and DPU SP board to the MAIN board. Disconnect the cable for rechargeable battery from the MAIN board. Disconnect the connection cable from the DPU SP board when the instrument has the gas sensing unit and AG IF board. Remove the shielding cover and DPU SP board from the MAIN board.





2. Remove the 3 screws (as shown with small arrows in the following picture) which secure the MAIN board to the block including the LCD unit. Disconnect the 3 cables (as shown with large arrows) from the MAIN board. Remove the MAIN board from the block which includes the LCDunit and operation board.

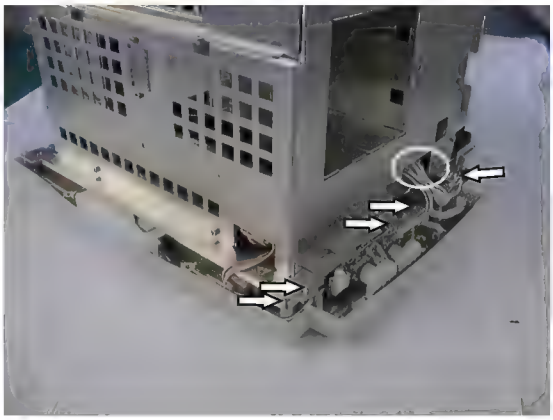


# Replacing the Touch Screen

**CAUTION**

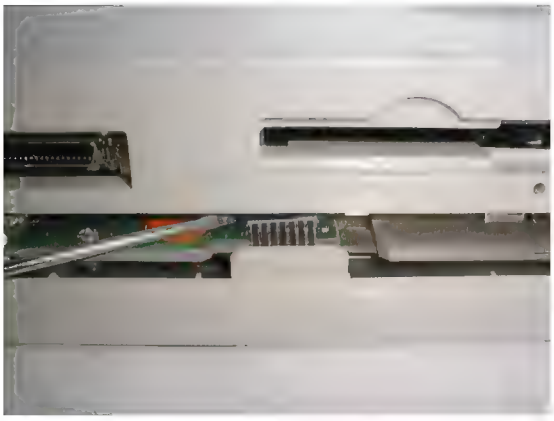
- **Since the touch screen is covered with glass, do not apply excessive mechanical shock such as dropping or pressure to the touch screen.**
- **Pay attention to the sharp glass parts such as the touch screen edges. It can cause cuts and injuries.**

1. After removing the rear enclosure at step 4, remove the 7 screws (as shown with arrows in the following two pictures) which secure the chassis block to the LCD unit. Disconnect the 2 cables (circled in the following two pictures) from the LCD unit and touch screen.



**CAUTION**

**To disconnect the film cable from the socket, pull up the cable stopper of the socket with a small flat-blade screwdriver so that the film cable is released.**



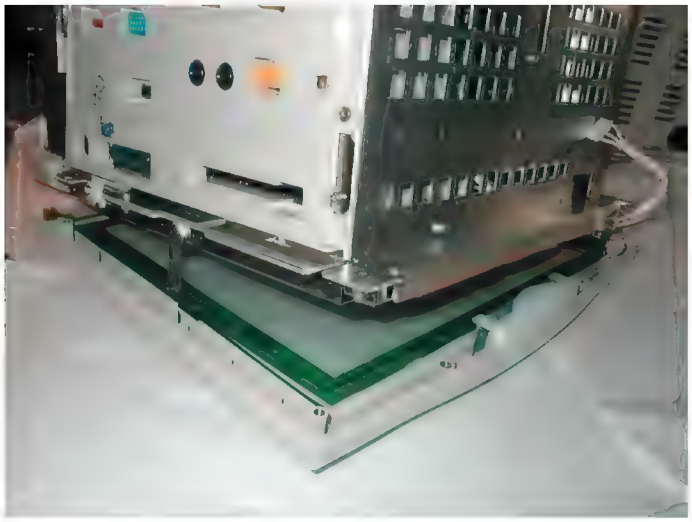
2. Slowly remove the chassis block from the front enclosure and check that the touch screen is left on the front enclosure.

---

**CAUTION**

**If the touch screen is adhered to the LCD unit, carefully peel the touch screen off.**

---



3. Remove the touch screen from the front enclosure. The front enclosure has two each of long and short gaskets which should be replaced with new ones when the touch screen is replaced.

4. Replace the touch screen with a new one. The new one must be placed on the original position of the front enclosure as shown below.

---

**CAUTION in Assembling the Instrument**

**Fit the touch screen onto the original position of the front enclosure. Otherwise, the touch screen will be broken when the chassis block is attached to the front enclosure.**

---

5. Carefully put the chassis block back to the original position and assmble the instrument by reversing the above procedure.

# Replacing the Backlight Lamps

1. After removing the chassis block from the front enclosure in step 2 in the "Replacing the Touch Screen" section, place the chassis block face up.

**CAUTION**

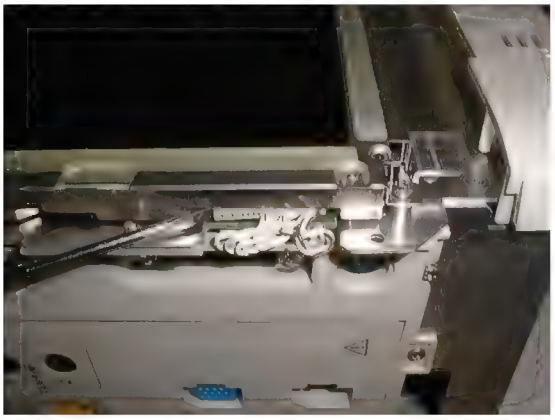
**Since the LCD unit is covered with glass, do not apply a mechanical shock such as dropping or pressure to the LCD unit.**

2. Disconnect the backlight lamp cable from the inverter board by using a small tip tool such as a small flat-blade screwdriver and inserting it into a space between the cable connector and socket.

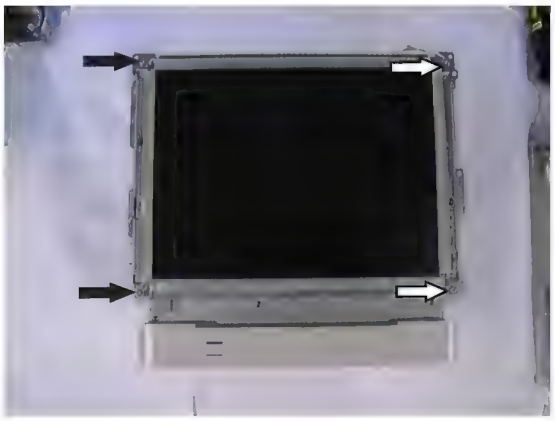
**CAUTION**

- **Be careful not to strain the cable.**
- **Check that the cable is not damaged. If the cable has even slight damage, it may break the vinyl of wire and short circuit may occur because a high voltage is output for the lamps through the cable.**

3. Disconnect the LCD cable from the LCD unit as shown below.



4. Remove the 4 screws which secure the LCD unit to the chassis block as shown below.



**CAUTION**

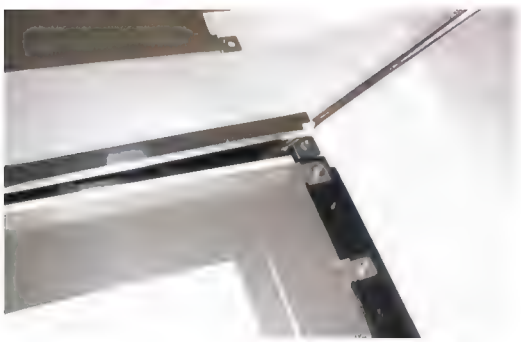
**Before placing the LCD unit face down on the table, check that the table is covered with a clean, soft and smooth material to avoid making the screen dirty or damaging the screen.**

5. Place the LCD unit face down on the table covered with a clean, soft and smooth material. Remove the 2 screws which secure the backlight lamp cover to the LCD unit. Slide it outward as shown with a large arrow in the following picture. Two backlight lamps are in the holder of the LCD unit.

**CAUTION**

**Handle the backlight lamp cover carefully because the cover edge may be sharp and can hurt you.**

6. Use a small tip tool such as small flat-blade screwdriver and carefully insert it between the lamp and holder at both ends. Replace the 2 backlight lamps with new ones.



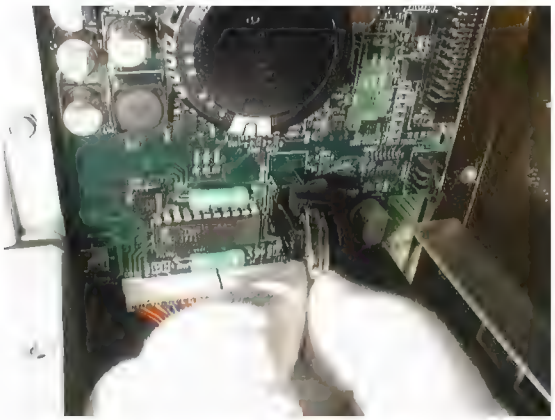
**CAUTION**

- **Be careful because the lamp can be easily broken.**
- **Since the lamp is covered with glass, do not apply a mechanical shock such as dropping or pressure to the lamp. If the lamp has a small crack, the gas composition in the lamp will gradually change and the lamp may deteriorate too much in a short period.**
- **Carefully handle the backlight lamp because the lamp edge may be sharp and can hurt you.**
- **Discard used backlight lamps (fluorescent tubes) according to your local laws.**

7. Carefully assemble the instrument by reversing the above procedure.

# Replacing the Lithium Battery

1. After removing the DPU SP board and shielding cover in step 18, replace the lithium battery with new one as shown below.



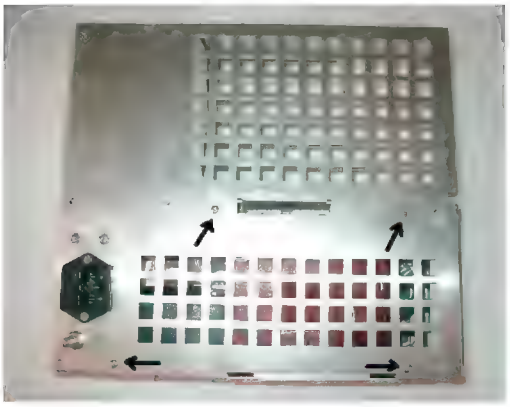
2. After replacing the battery, check the continuity between the battery terminal and receptacle terminal with a multimeter or digital voltmeter.

**CAUTION**

- **Use a glove to handle the new lithium battery. If you touch it with your bare hand, it may cause an increase of resistance at the battery terminals and shorten the lifetime.**
- **Never charge, short-circuit, disassemble, deform, heat, or throw the battery into fire. This may cause overheating, explosion, or fire.**
- **Before disposing of the battery, cover it with insulation tape to prevent short circuit between the positive and negative terminals. Otherwise, the battery may heat, explode or burn if the battery is disposed of with other batteries or electrically conductive materials.**
- **Discard used batteries according to your local laws.**

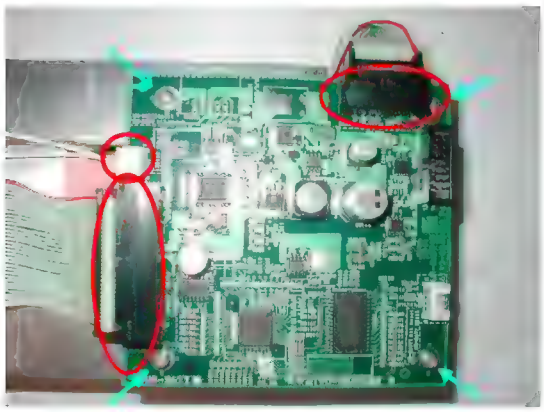
# Replacing the Gas Sensing Unit and AG IF Board (BSM-5135/5136 only)

After removing the rear chassis from the instrument in step 6 in the "Opening the Instrument" section, remove the 4 screws which secure the gas sensing unit and AG IF board to the rear chassis. Remove the unit and board from the rear chassis.

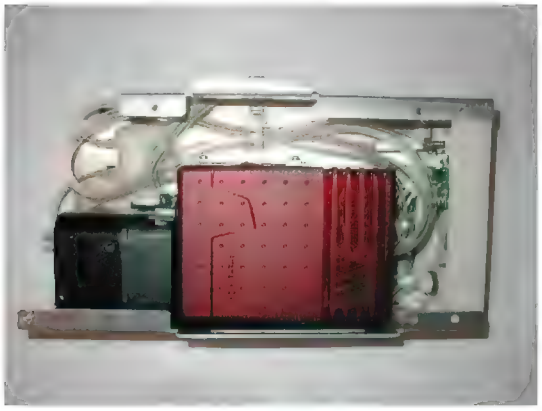


## Removing the AG IF Board

Disconnect the 3 cables (circled in the following picture) from the AG IF board. Remove the 4 screws (shown with the arrows in the picture) which secure the AG IF board to the gas sensing unit. Remove the board from the gas sensing unit.



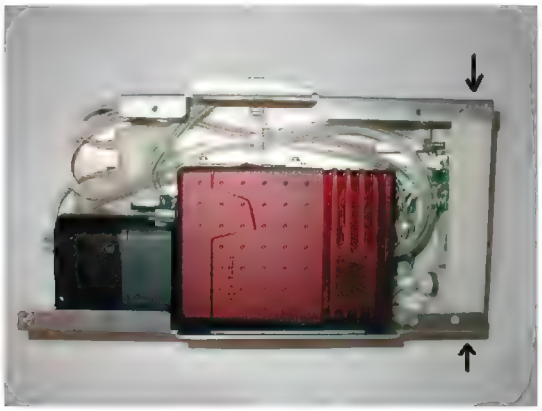
The following picture shows the gas sensing unit which consists of the AION unit, oxygen transducer and Dryline receptacle.



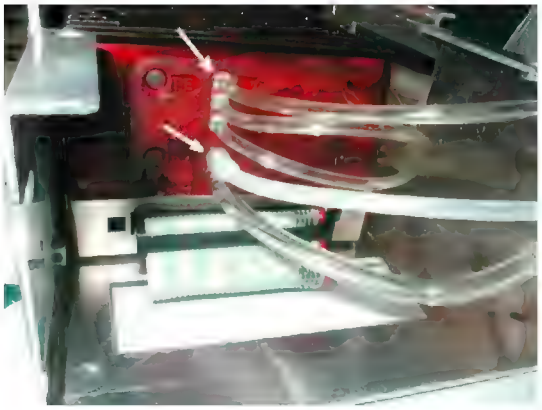
## Replacing the Dryline Receptacle

The Dryline receptacle must be replaced with a new one every year according to the following procedure.

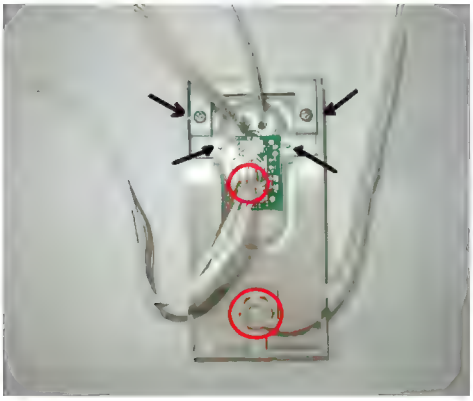
1. Remove the 2 screws (shown with arrows in the following picture) which secure the side panel including the Dryline receptacle. Remove the side panel with the tubes connected.



2. Disconnect the 2 tubes (shown with arrows in the following picture) from the AION unit.



3. Disconnect the cable and tube (circled in the following left picture) from the side panel. Remove the 4 screws (shown with arrows in the picture) which secure the Dryline receptacle to the side panel.

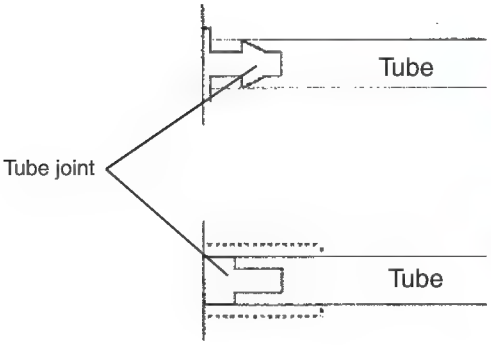


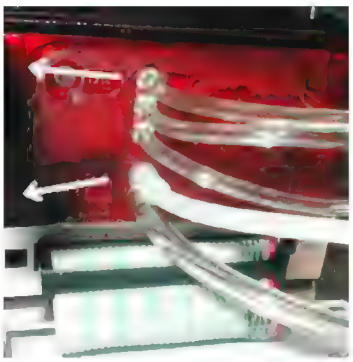
4. Replace the Dryline receptacle with a new one and assemble the gas sensing unit and AG IF board by reversing the above procedure and observing the following Cautions.

---

## CAUTION in Assembling the Instrument

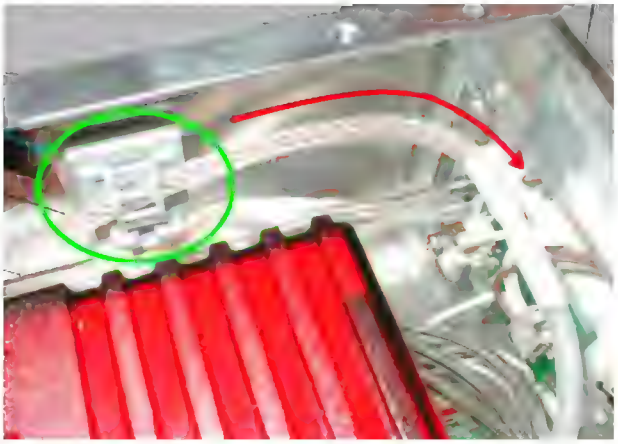
- **The tubes must be completely inserted into the tube joint as shown below.**



- **Do not fold or kink the tubes at any point while arranging the tubes in the gas sensing unit.**
- **Arrange the urethane tube for gas exhast port in the gas sensing unit and check that the tube has no fold or kink, especially around the Luer-lock fittings circled in the following picture.**

- **Arrange the nafion tube in the gas sensing unit as shown with the arrow in the following picture and fasten the tube with the tube binder (circled in the picture).**



# Replacing the Rechargeable Battery (Option)

1. Remove the 2 bind head screws which secure the battery cover to the bottom of the rear enclosure as shown below.

2. Slide off the battery cover in the direction of the large arrow in the above picture.

3. Replace the rechargeable battery with a new one.

4. Attah the battery cover to the bottom of the rear enclosure with the 2 bind head screws.

# *Section 6 Maintenance*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Required Tools ..... 6.1
Measuring and Test Equipment ..... 6.2
YS-073P8 Board/Unit Maintenance Kit ..... 6.3
- Composition ..... 6.3
- Connection ..... 6.3
- Connection Diagram ..... 6.5

Maintenance Check Items and Schedule ..... 6.6
- External ..... 6.6
- Input Conditions ..... 6.6
- Operation ..... 6.7
- Display ..... 6.7
- Recorder ..... 6.7
- Vital Sign Parameters ..... 6.8
- Power ..... 6.8
- Data Backup ..... 6.9
- Safety ..... 6.9
- Others ..... 6.10

# To Be Replaced Periodically

**CAUTION**

**• When attaching the new Dryline receptacle to the side panel, carefully tighten the two screws.**
**Tightening the screw too much may break the Dryline receptacle.**
**• Failure to replace the Dryline receptacle with a new one every year will cause a malfunction of the gas sensors because moisture in the respiration circuit comes into the instrument.**

We recommend the periodic replacement of the following components according to the expected life span.

| NK Code No. | Description | Expected Life Span |
|---|---|---|
| 609842 | Dryline receptacle | Once a year |
| X060 | Battery pack NKB-101 | Once a year |
| 585876 | Backlight assembly for LCD unit | Approx. 25000 hours or 2 years and 10 months or more of continuous operation |
| 481809 | Lithium battery for clock operation backup | Approx. 6 years or more |
| 6114-053114C | Platen roller | Approx. 6 years or more |
| 107002 | Retainer ring | Must be replaced with a new one when the platen roller is replaced. |
| 445074 | Thermal array head | Approx. 250 stacks or more of the recording paper |
| 445109C | Paper drive motor | Approx. 6000 stacks or more of the recording paper |

# Required Tools

- Large and small Phillips screwdrivers (insulated)
- Small flat-blade screwdriver (insulated)
- Anti-static bench mat connected to appropriate ground
- Anti-static wrist strap connected to appropriate ground
- 3 mm hex socket driver
- Tweezers
- Nippers
- Cable ties

# Measuring and Test Equipment

To repair, check, or adjust the instrument, the following measuring and test equipment or equipment with similar function and performance is required.

### Digital Voltmeter

A digital tester with at least 3-1/2 digits LCD display that can measure voltage, current, and resistance.

### Cathode-ray Oscilloscope

An oscilloscope with a bandwidth of more than 1 MHz and a sensitivity of more than 10 mV/cm.

### Function Generator

A function generator with a range of 1 Hz to at least 1 kHz with 1% or better frequency accuracy.

### AX-800P Vital Sign Simulator

The simulator outputs simulated waveforms, i.e. ECG waveform, respiration curve, 4 blood pressure waveforms, 2 temperature fixed values, and cardiac output curve.

### 548631A Adapter Cable

Although the simulator has the connection cable for previous bedside monitors such as BSM-2100/3101/7000/8300/8502/8800, the new bedside monitors such as BSM-1100/2301/4100/9510 and BSS-9800 require this adapter cable instead of the previous bedside monitor connection cable.

### YS-077P1 NIBP Dummy Cuff

A 700 ml container that is needed for some NIBP diagnostic check items.

### YS-077P2 NIBP Dummy Cuff

A 250 ml container that is needed for some NIBP diagnostic check items.

### YS-073P8 Board/Unit Maintenance Kit

Designed for the maintenance of the boards and units for BSM-4100 series and WEP-4204/4208.

### Air regulator

### Gas flowmeter

### Wattmeter

# YS-073P8 Board/Unit Maintenance Kit

## Composition

The kit consists of the following.

- Extension boards: 11 pcs.
- Extension cables: 11 pcs.
- 80-pin connectors: 2 pcs.

## Connection

Refer to Connection Diagram as shown below.

- Extension boards

DEBUG1: Connects the MAIN board and DPU board. The two 80-pin connectors of this kit let you align the DPU board either vertical or horizontal to the MAIN board. The desired connector (vertical or horizontal) must be soldered on the DEBUG1 board. The connector has a triangle mark which must be matched with pin 1A of CN102 on the DEBUG1 board.

DEBUG2: Connects the MAIN board to the DEBUG3 board with the CNA2 and CNA3 cables.

DEBUG3: Connects the Connection board to the DEBUG2 board with the CNA2 and CNA3 cables.

EXT1: Connects the Operation, Power SW and alarm indicator boards to the MAIN board with the CNA6 cable.

EXT2: Connects the recorder unit and speaker to the MAIN board with the CNA7, CNA8 and CNA10 cables. The EXT2 board has +5 V DC input and ground terminals and two resistors for the recorder unit adjustment so that the output from the photo transistor of the recorder unit can be adjusted with a digital voltmeter when the recorder unit, EXT2 board and +5 V DC supply are connected. Refer to Section 7 ADJUSTMENT. Set the jumper setting as follows:

Short circuit of pins 1 and 2: Enables to directly receive +5 V DC from a DC power supply.

Short circuit of pins 3 and 4: Enables to receive +5 V DC from the power supply unit when the MAIN board is connected to the EXT2 board.

EXT3: Connects the motherboard to the EXT6 board with the CNA9 cable. The EXT3 board has two connectors each for the motherboard and cable.

EXT4: Connects the ECG RESP2 or ECG RESP3 board to the EXT5 board with the CNA5 cable.

EXT5: Connects the ECG RESP1 or MP1 board to the EXT4 board with the CNA5 cable.

EXT6: Connect the ECG RESP2 or ECG RESP3 board to the EXT3 with the CNA9 cable. The EXT6 board has two connectors each for the analog board and cable.

EXT7: Connects the $SpO_2$, MP2 or MP3 board to the EXT8 board with the

CNA9 cable. The EXT7 board has one connector each for the analog board and cable.

EXT8: Connects the motherboard to the EXT7 board with the CNA9 cable. The EXT8 board has one connector each for the motherboard and cable.

- Extension cables

CNA1 (50 cm long): Extends the distance between the MAIN and Inverter boards.

CNA2 (30 cm long): Extends the distance between the DEBUG2 and DEBUG3 boards. The cable is used for touch screen signals.

CNA3 (30 cm long): Extends the distance between the DEBUG2 and DEBUG3 boards. The cable is used for the LCD unit display signals.

CNA4 (50 cm long): Extends the distance between the DPU board and motherboard.

CNA5 (20 cm long): Extends the distance between the EXT4 and EXT5 boards.

CNA6 (50 cm long): Extends the distance between the MAIN and EXT1 boards.

CNA7 (50 cm long): Extends the distance between the MAIN and EXT2 boards. The cable is used for the paper drive motor control signals and photo sensor signals.

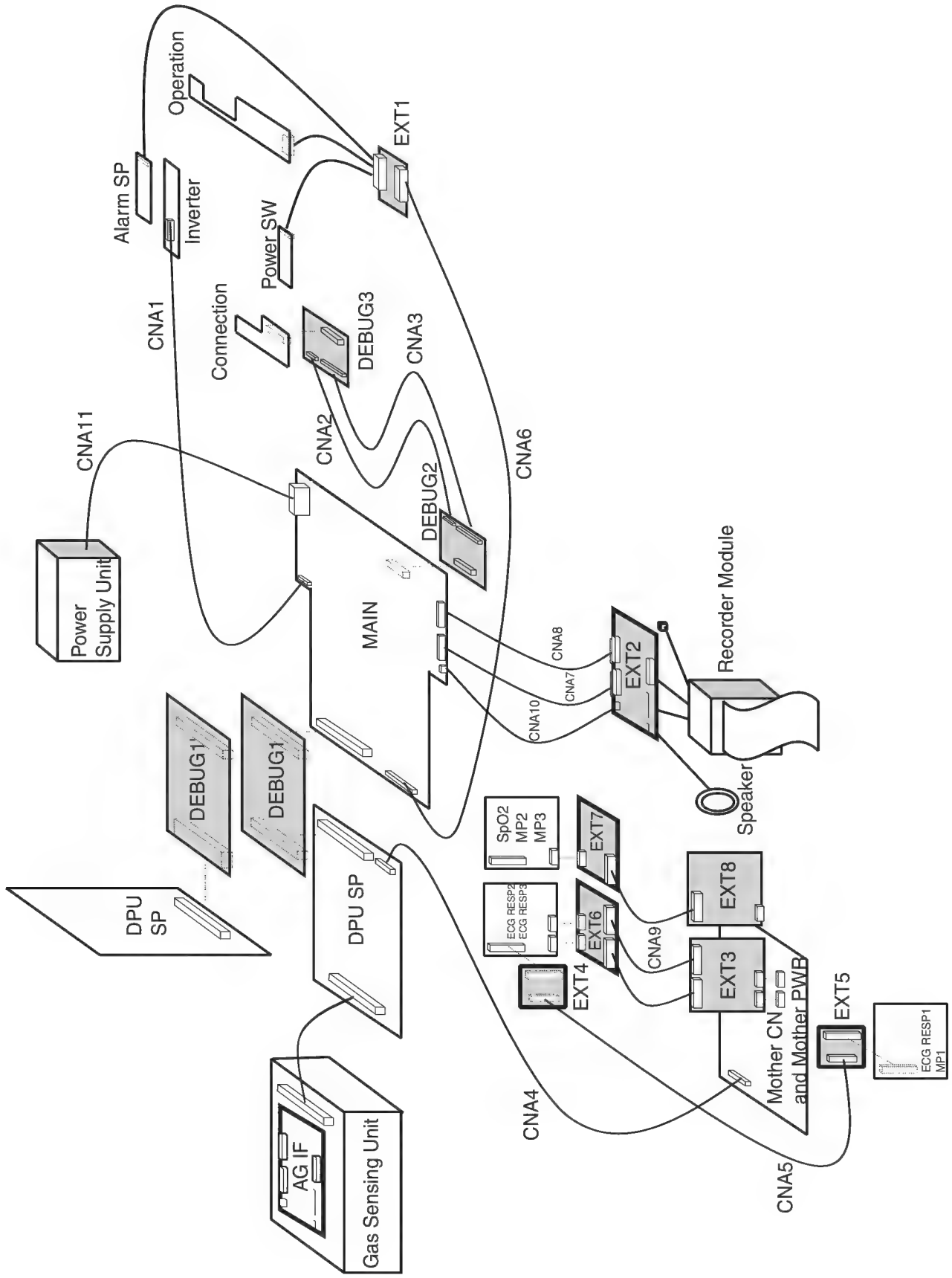
CNA8 (50 cm long): Extends the distance between the MAIN and EXT2 boards. The cable is used for the thermal array head control signals.

CNA9 (20 cm long): Extends the distance between the EXT3 and EXT6 boards and between the EXT8 and EXT7 boards.

CNA10 (50 cm long): Extends the distance between the MAIN and EXT2 boards. The cable is used for the speaker.

CNA11 (70 cm long): Extends the distance between the MAIN board and power supply unit.

## Connection Diagram



# Maintenance Check Items and Schedule

Perform this maintenance check once every six months.

A maintenance check sheet is provided at the end of this section. Make a copy of this check sheet before using it. The check items are grouped as follows:

- External
- Input conditions
- Operation
- Display
- Recorder
- Vital sign parameters
- Power
- Data backup
- Safety
- Others

Following are the procedures for each check item.

## External

| Item | Check Procedure | Action |
|---|---|---|
| Dirt, stain or crack | Check that there is no dirt, stain and crack on the instrument. | If the instrument is dirty, clean it with a cloth moistened with water, neutral soap or alcohol. If the instrument has stain or crack, remove it or replace the stained or cracked part with a new one. |
| Damaged switch or key top cover | Check that there are no physically damaged switches and key top covers. | If any switch or key top cover is damaged, replace it with a new one. |
| Exhaust gas adapter tube connection | Check that the exhaust gas adapter tube is firmly attached to the EXHAUST outlet on the side panel of the instrument and the lock mechanism of the tube connector works. | Remove the cause if the tube is loosely attached to the outlet. |

## Input Conditions

| Item | Check Procedure | Action |
|---|---|---|
| Contact between input socket on the instrument and connector of connection cord | Check that there is good contact between the input socket and connector of the connection cord. | Remove the cause if there is a poor contact between them. |
| Input socket on the instrument and connector of connection cord | Visually check that there is no damaged input socket and connector. | If the input socket or connector is damaged, replace it with a new one. |
| Electrode lead wire and connection cord | Visually check that there is no damage of the lead wire and connection cord. | If the electrode lead wire or connection cord has a damage, replace it with a new one. |

## Operation

| Item | Check Procedure | Action |
|---|---|---|
| Key function on the operation panel | Check that the function of each key on the control panel works correctly. | Remove the cause if the key function is wrong. |
| Touch screen key function | Check that the function of each key on the screen works correctly. | Remove the cause if the key function is wrong. |

## Display

| Item | Check Procedure | Action |
|---|---|---|
| Crack, scratch or dirt | Check that there is no crack, scratch or dirt on the touch screen. | If there is a crack or scratch on the screen, replace it with a new one. If the screen is dirty, clean it with a soft cloth moistened with water. |
| Display control settings | Check that the control settings such as brightness work correctly. | If one of the control settings has no function, remove the cause. |
| Minimum brightness control | Check that the waveforms and data do not disappear when the brightness is set to minimum on the screen. | Remove the cause if the waveforms or data disappear from the screen. |
| CRTC check | Check that there is no error on the screen when performing the CRTC checks on the Manual Check Menu screen. | Remove the cause if an error occurs. |

## Recorder

| Item | Check Procedure | Action |
|---|---|---|
| Waveform and character data on paper | Check that the waveform and character data on the paper are clear. | If the waveform or character data is not clear, clean the thermal array head. Refer to the operator's manual. |
| Recording paper | Check that Nihon Kohden recording paper is used. | If unspecified paper is used, replace it with Nihon Kohden specified paper. |
| Paper drive check | Check that the paper moves at a preset paper speed without snaking. | Remove the cause if the paper moves abnormally. |
| Abnormal sound | Check that the motor and gears do not generate abnormal sound. | Remove the cause if there is abnormal sound. |
| Mark detection | Check that the mark detection works correctly. | Remove the cause if the mark detection does not work. |
| Recorder check in WS Check mode | Check that there is no error on the paper when performing the recorder check in the WS Check mode. Refer to Section 3. | Replace the MAIN board or other component with a new one according to the WS Check Mode section. |
| Printed date and time check | Check that the correct date and time are printed on the paper. | Remove the cause if the date and time is wrong or not printed. |

## Vital Sign Parameters

| Item | Check Procedure | Action |
|---|---|---|
| Waveform and numeric data | Check that ECG, respiration, blood pressure waveforms, their parameters and temperature data are displayed correctly and QRS synchronous sound is generated when connecting AX-800P vital sign simulator to the instrument. | If there is anything wrong, check the connection between the AX-800P and instrument and remove the cause. |
| SpO2 and NIBP | Check that the displays of SpO2 and NIBP parameters are acceptable when applying the SpO2 probe and NIBP cuff to a healthy person or yourself. | If there is a big difference, check the connection between the healthy person and instrument and remove the cause. |
| NIBP check | Check that there is no error on the screen when performing the NIBP checks on the Manual Check Menu screen. | Remove the cause if an error occurs. |
| Multi-parameter socket function | Check that the connection cord is recognized and the related parameter is displayed when connecting the connection cord to the socket. | If the socket has no function, plug the connection cord into the other multi-parameter sockets and check which one is wrong, connection cord or instrument. |
| Zero balance of IBP | Check that the blood pressure transducer is zero balanced when connecting the transducer to the instrument through the IBP connection cord and pressing "ALL ZERO" key or multi-parameter key on the screen. | If the transducer is still imbalanced after zeroing, connect the transducer to the other multi-parameter sockets and check which one is wrong, transducer or instrument. |
| Alarm function | Check that the alarm mark appears on the screen, the alarm indicator works, and the alarm sounds when an alarm occurs. | If there is anything wrong, check the corresponding part. |
| Transducer | Check that the specified sensor and transducer are used. | If the unspecified sensor or transducer is used, replace it with the specified one. |
| Accuracy check with calibration gas | When the calibration gas is input into the instrument, check that each gas is measured within the following acceptable range.<br>- $CO_2$: Atmospheric pressure × 0.05± 2 mmHg<br>- $N_2O$: 40 ± 3%<br>- $O_2$: 52 ± 2%<br>- Iso: 3.0 ± 0.2% | Perform the gas calibration according to the operator's manual if a data is not within the acceptable range. |

## Power

| Item | Check Procedure | Action |
|---|---|---|
| Power cord | Check that the power cord does not have any damage, poor continuity, heat, sound or smell while bending each part of the power cord. | If the power cord has a malfunction, replace it with a new one. |
| Ground lead | Check that the ground lead has no damage and no poor continuity while bending each part of the ground lead. | If the ground lead has a malfunction, replace it with a new one. |
| Fuse | Check that the specified fuses are used and not blown. | If the fuse is blown, replace it with a new one after removing the cause. |
| Power indicator and supply voltage check | Check that the power indicators such as the power lamp, AC power lamp and battery power lamp works properly and the correct voltages are output from the power supply unit. | Remove the cause if there is anything wrong. |
| Maximum power consumption check | Check that "CHECK SAMPLE LINE" message appears on the screen and the additional power consumption is 40VA or less when completely cramping the Dryline tube connected to the instrument. | Remove the cause if more than 40 VA additional consumption is measured with a wattemeter. |

## Data Backup

| Item | Check Procedure | Action |
|---|---|---|
| System Setup data backup | Check that the System Setup data is saved for a long time after the power is turned off. | If the System Setup data disappears within 30 minutes after the power off, replace the super capacitor on the MAIN board with a new one. |
| Clock function backup | Check that the clock function works correctly when the power is turned on. | If the clock stops while the instrument is turned off, replace the lithium battery on the MAIN board with a new one. |

## Safety

Perform the following patient safety check after repairing the instrument.

| Item | | Check Procedure | Action |
|---|---|---|---|
| Protective earth impedance (refer to IEC 60601-1-18.(f)) | | Check that the impedance between the protective earth contact and any accessible metal part does not exceed 0.1 Ω. | Remove the cause if the impedance exceeds 0.1 Ω |
| Earth leakage current (refer to IEC 60601-1 19) | | Check that the earth leakage current does not exceed 0.5 mArms under normal condition and 1.0 mArms under each single fault condition. | Remove the cause if the earth leakage current exceeds one of the maximum values. |
| Enclosure leakage current (refer to IEC 60601-1 19) | | Check that the enclosure leakage current does not exceed 0.1 mArms under normal condition and 0.5 mArms under each single fault condition. | Remove the cause if the enclosure leakage current exceeds one of the maximum values. |
| Patient leakage current (refer to IEC 60601-1 19) | Patient leakage current | Check that the patient leakage current to type CF or defibrillation-proof type CF applied part does not exceed 0.01 mArms under normal condition and 0.05 mArms under each single fault condition. | Remove the cause if the patient leakage current exceeds one of the maximum values. |
| | | Check that the patient leakage current to type BF or defibrillation-proof type BF applied part does not exceed 0.1 mArms under normal condition and 0.5 mArms under each single fault condition. | |
| | Patient leakage current (mains voltage on the applied part) | Check that the patient leakage current to type CF or defibrillation-proof type CF applied part does not exceed 0.05 mArms under each single fault condition. | |
| | | Check that the patient leakage current to type BF or defibrillation-proof type BF applied part does not exceed 5 mArms under each single fault condition. | |
| Dielectric strength (refer to IEC 60601-1 20) | | Check that the instrument has the following withstand voltages.<br>• A-a1: 1500 V AC for one minute<br>• A-f: 1500 V AC for one minute<br>• B-a: 4000 V AC for one minute<br>• B-d: 1500 V AC for one minute | Remove the cause if the instrument does not have all the withstand voltages. |

## Others

| Item | Check Procedure | Action |
|---|---|---|
| Line voltage | Check that the line voltage is within the range of nominal voltage ±10%. | Use only the line voltage within the correct range. |
| Connection to other equipment | Check that the instrument is correctly connected to other equipment according to the operator's manual. | If there is a wrong connection, connect the equipment to the instrument correctly according to the operator's manual. |
| Vibration or resonant sound | Check that the instrument has no abnormal vibration or resonant sound. | Remove the cause of abnormal vibration or resonant sound. |
| Screws | Check that there are no loose screws. | If any screw is loose, tighten it. |
| Option check | Check that there is no error on the screen when performing the optional card checks such as Network Card Check on the Manual Check Menu screen. | Remove the cause if an error occurs. |
| Installation condition check | Check that the instrument is installed in a suitable location according to the operator's manual. | If the conditions are not suitable, improve them. |

## Maintenance Check Sheet

(Refer to the Maintenance section of the service manual for details.)

Customer: _____ Customer Address: _____

Service Personnel: _____ Service Company: _____

Instrument Name: _____ Instrument Model: _____

Instrument Serial Number: _____ Hardware Revision: _____

Software Revision: _____

**External**

| | | |
|---|---|---|
| There is no dirt, stain, and crack on the instrument. | Yes | No |
| There are no damaged switches and key top covers. | Yes | No |
| The warning and caution labels are clearly readable. | Yes | No |
| The exhaust gas adapter tube is firmly connected to the EXHAUST outlet. | Yes | No |

**Input Conditions**

| | | |
|---|---|---|
| There is good contact between the input socket on the instrument and connector of the connection cord. | Yes | No |
| There is no damage on the input socket and connection cord connector. | Yes | No |
| There is no damage and internal cut on the lead wire and connection cord. | Yes | No |

**Operation Keys**

| | | |
|---|---|---|
| The function of each key on the operation panel works correctly. | Yes | No |
| The function of each key on the screen works correctly. | Yes | No |

**Display**

| | | |
|---|---|---|
| The brightness is correctly adjusted. | Yes | No |
| There is no distortion on the screen. | Yes | No |
| Alarm indicator works properly. | Yes | No |

**Vital Sign Parameters**

| | | |
|---|---|---|
| ECG waveform, heart rate, and QRS synchronous mark are properly displayed with QRS synchronous sound generated. | Yes | No |
| Respiration waveform and respiration rate are properly displayed. | Yes | No |
| Plethysmographic pulse waveform and $SpO_2$ data are properly displayed. | Yes | No |
| NIBP data (systolic, diastolic and mean blood pressures) are acceptable. | Yes | No |
| Multi-parameter sockets recognize the respective connection cords and the waveforms and data are properly displayed. | Yes | No |
| "ALL ZERO" key and multi-parameter key on the screen allow zero balance of the blood pressure transducer. | Yes | No |
| Alarm functions properly. | Yes | No |
| Alarm sound works properly. | Yes | No |
| Specified sensor and transducers are used. | Yes | No |
| Each gas component of the calibration gas is measured within the acceptable range. | Yes | No |

**Recorder**

| | | |
|---|---|---|
| Waveforms are clearly recorded on the paper. | Yes | No |
| Alphanumeric data is clearly recorded on the paper. | Yes | No |
| Date and time is recorded on the paper. | Yes | No |
| Specified recording paper is used. | Yes | No |

**Data Backup**

| | | |
|---|---|---|
| System setup data is saved. | Yes | No |
| Clock function works properly while the instrument is turned off. | Yes | No |

**Power**

| | | |
|---|---|---|
| Power cord (and ground lead) are not damaged. | Yes | No |
| Instrument is firmly grounded to a dedicated grounding terminal. | Yes | No |
| Fuse is the correct rating. | Yes | No |
| The additional power consumption is 40VA or less when the Dryline tube is completely cramped. | Yes | No |

**Safety**

| | | |
|---|---|---|
| Protective earth impedance is less than prescribed limit. | Yes | No |
| Earth leakage current is less than prescribed limits. | Yes | No |
| Enclosure leakage current is less than prescribed limits. | Yes | No |
| Patient leakage current is less than prescribed limits. | Yes | No |
| Withstand voltages of instrument are prescribed voltage and time limits or more. | Yes | No |

**Others**

| | | |
|---|---|---|
| Line voltage is within the range of nominal voltage ±10%. | Yes | No |
| Instrument is correctly connected to other equipment. | Yes | No |
| All screws are tight. | Yes | No |

# *Section 7 Adjustment*

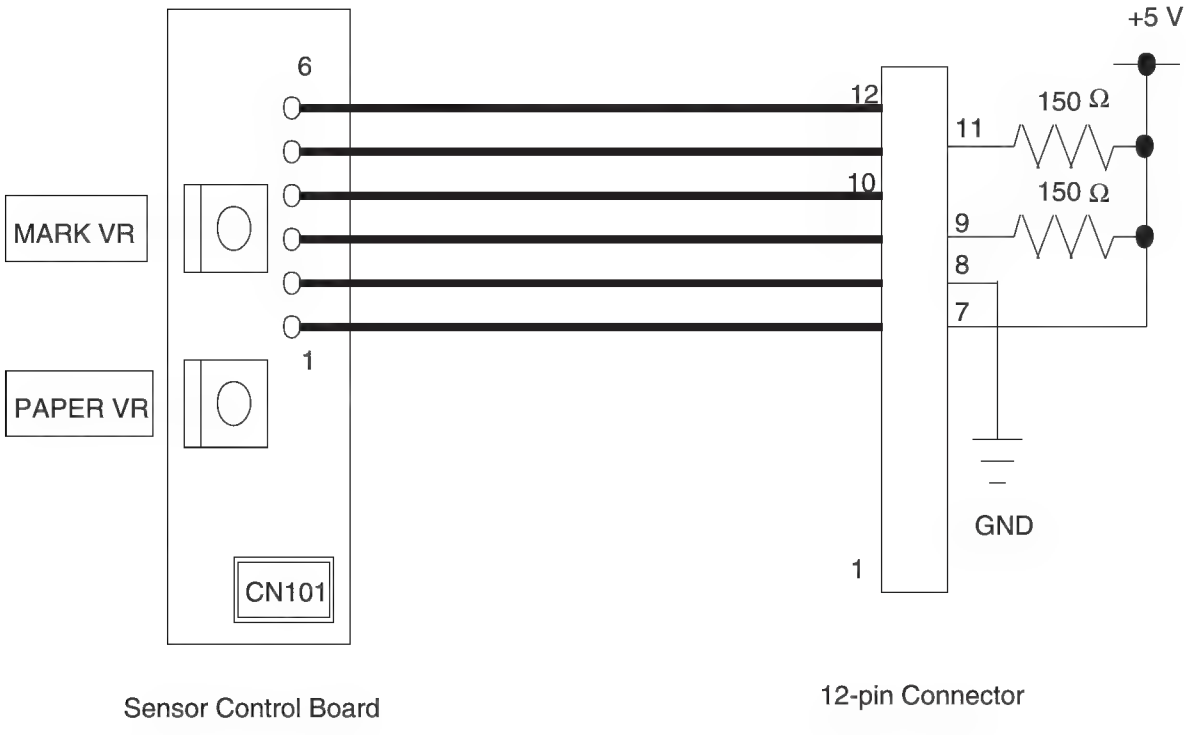

Sensors in the Recorder Unit ..... 7.1
Adjusting the Output Voltages with Digital or Analog Multimeter ..... 7.1
Adjusting the Output Voltages with the YS-073P8 Board/Unit Maintenance Kit and Digital or Analog Multimeter ..... 7.2
Adjusting the Output Voltages with the YS-073P8 Board/Unit Maintenance Kit and Oscilloscope ..... 7.2

# Sensors in the Recorder Unit

After you replace the sensor board of the recorder unit with a new one, adjust the paper and mark detection output voltages on the sensor control board as shown below.

## Adjusting the Output Voltages with Digital or Analog Multimeter

1. Connect 150 Ω resistors to pins 9 and 11 of the 12-pin connector cable from the sensor control board as shown below.
2. Connect +5 V DC of a +5 V DC power supply to the two resistors and pin 7 of the 12-pin connector as shown below.
3. Connect the ground terminal of the +5 V DC power supply to pin 8 of the 12-pin connector.
4. Set the recording paper inside the paper magazine according to the operator's manual "Loading the Recording Paper" in Section 2 PREPARATIONS.
5. Draw out one page of the recording paper so that the small black square on the corner of the paper is not over the mark detection sensor.
6. Adjust the PAPER VR and MARK VR so that pins 10 (PAPER output) and 12 (MARK output) of the 12-pin connector output a voltage within the range of 3.5 V DC to 4.0 V DC, respectively when the two sensors detect the white part of the paper.

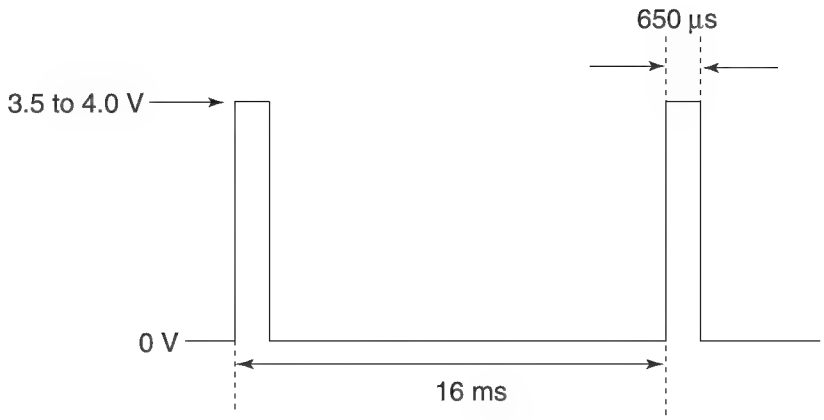


## Adjusting the Output Voltages with the YS-073P8 Board/Unit Maintenance Kit and Digital or Analog Multimeter

1. Connect the EXT2 board of the kit to the recorder unit. Refer to "YS-073P8 Board/Unit Maintenance Kit" in Section 6.
2. Short pins 1 and 2 at the jumper setting terminal on the EXT2 board.
3. Connect +5 V DC of a +5 V DC power supply to the +5 V input terminal on the EXT2 board.
4. Connect the ground terminal of the +5 V DC power supply to the ground terminal on the EXT2 board.
5. Set the recording paper inside the paper magazine according to the operator's manual "Loading the Recording Paper" in Section 2 PREPARATIONS.
6. Draw out one page of the recording paper so that the small black square on the corner of the paper is not over the mark detection sensor.
7. Adjust the PAPER VR and MARK VR so that the PAPER and MARK test pins on the EXT2 board output a voltage within the range of 3.5 V DC to 4.0 V DC when the two sensors detect the white part of the paper.

## Adjusting the Output Voltages with the YS-073P8 Board/Unit Maintenance Kit and Oscilloscope

1. Connect the EXT2 board between the recorder unit and MAIN board connected to the instrument. Refer to "YS-073P8 Board/Unit Maintenance Kit" in Section 6.
2. Short pins 3 and 4 at the jumper setting terminal on the EXT2 board.
3. Turn on the instrument.
4. Set the recording paper inside the paper magazine according to the operator's manual "Loading the Recording Paper" in Section 2 PREPARATIONS.
5. Draw out one page of the recording paper so that the small black square on the corner of the paper is not over the mark detection sensor.
6. Connect the probe of the oscilloscope to the PAPER or MARK test pin on the EXT2 board.
7. Connect the ground clip of the oscilloscope to the ground pin on the EXT2 board. The following rectangular waveform (16 ms interval) appears on the screen of the oscilloscope.




8. Adjust the PAPER VR and MARK VR so that the PAPER and MARK test pins on the EXT2 board output the rectangular amplitude within the range of 3.5 V DC to 4.0 V DC when the two sensors detect the white part of the paper.

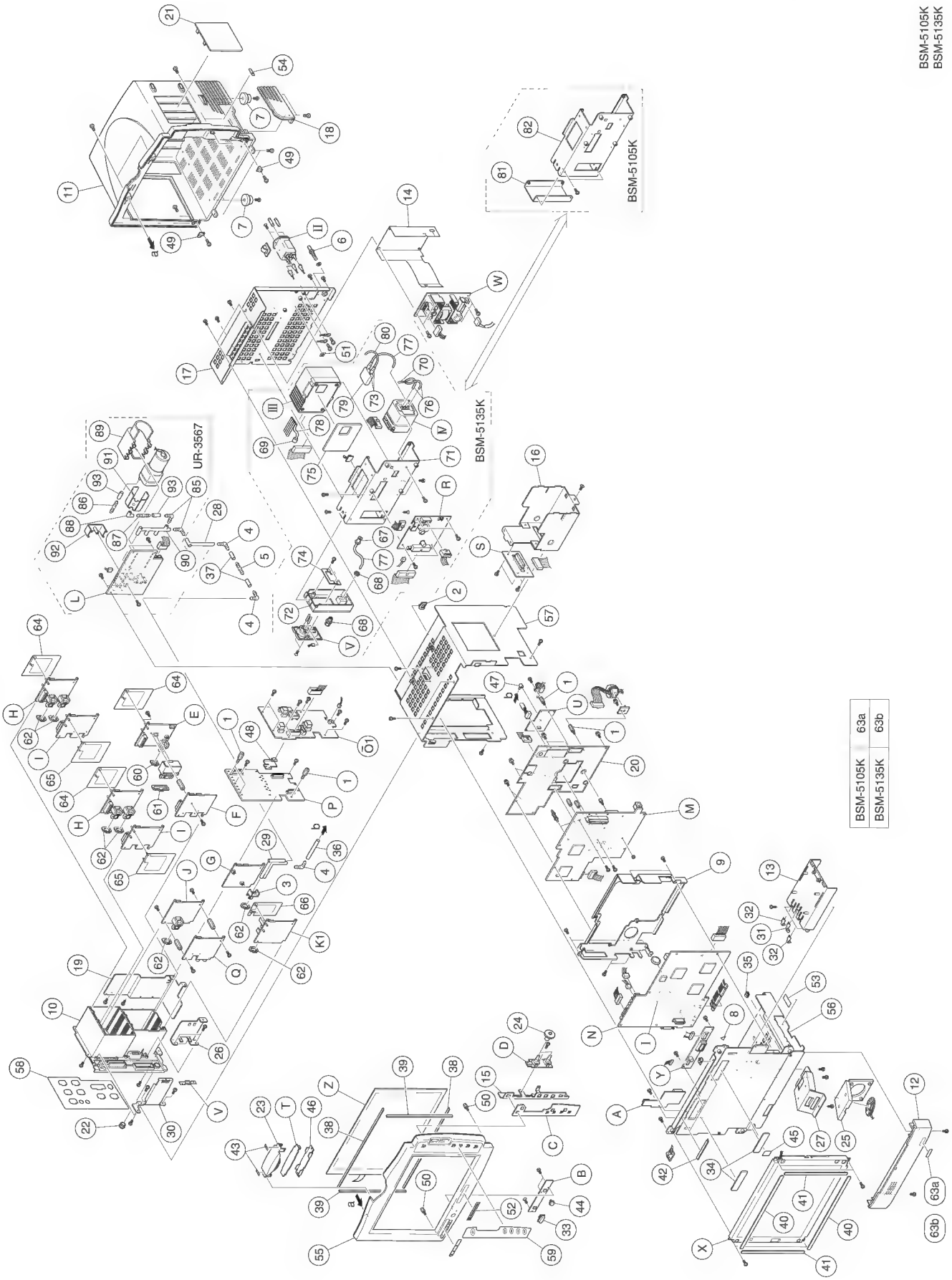
# *Section 8 Replaceable Parts List*

Bedside Monitor BSM-5105/5135 ..... 8.2
Bedside Monitor BSM-5106/5136 ..... 8.8
WS-510P Recorder Module (Option) ..... 8.14
RG-921P Paper Drive Unit for WS-510P Recorder Module ..... 8.16

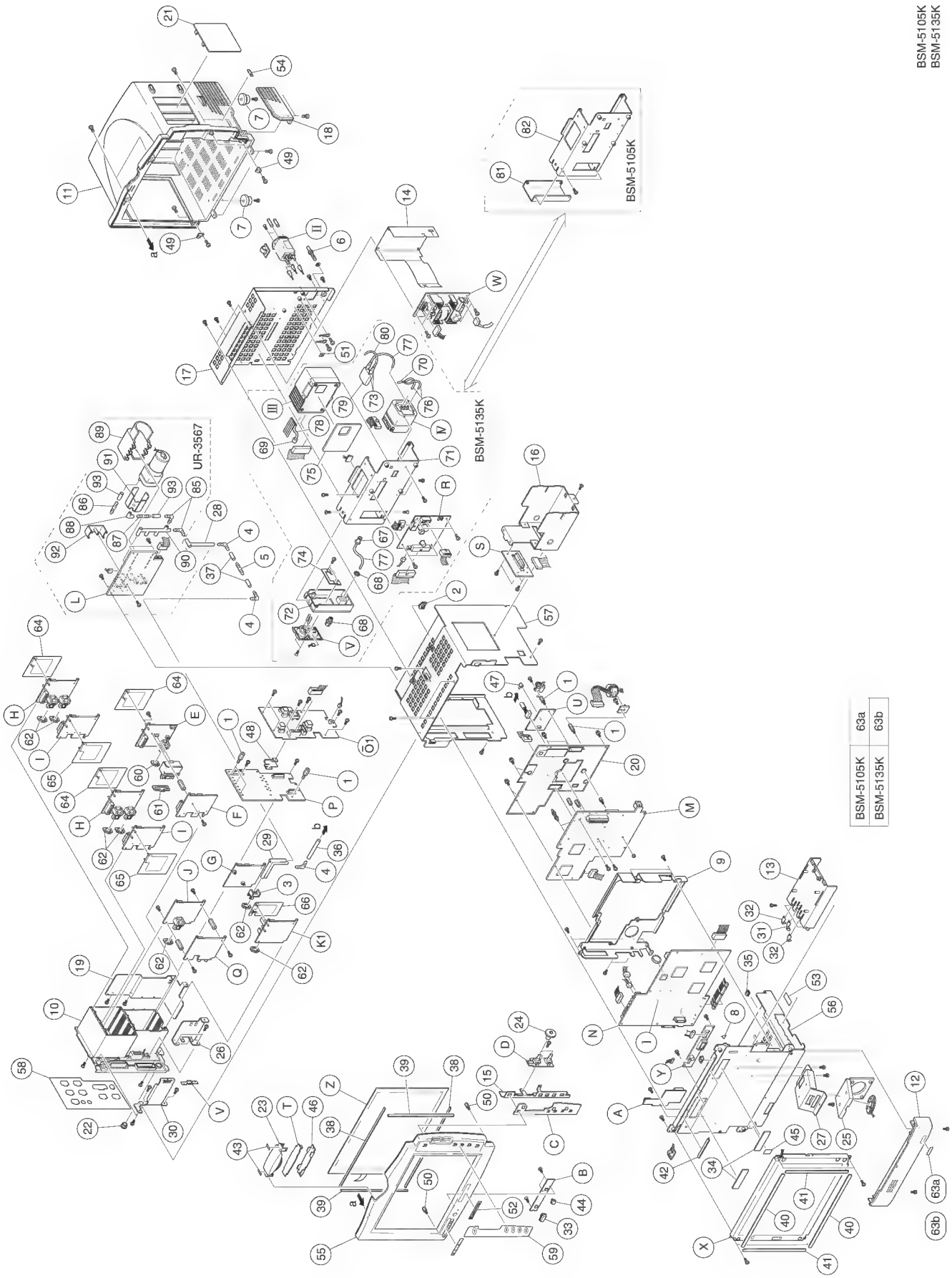
When ordering parts or accessories from your nearest Nihon Kohden Corporation distributor, please quote the NK code number and part name which are listed in this service manual, and the name or model of the unit in which the required part is located. This will help us to promptly attend to your needs. Always use Nihon Kohden parts and accessories to assure maximum performance from your instrument.

# Bedside Monitor BSM-5105/5135

| Index | NK Code No. | Qty | Description | |
|---|---|---|---|---|
| 1 | 127907 | 5 | Spacer bolt | カンカクボルト |
| 2 | 132991 | 1 | Holder | ユツジホルダー |
| 3 | 515542B | 1 | NIBP socket | NIBP　ソケット |
| 4 | 531337 | 3 | Plastic elbow tube | L型継ぎ手 |
| 5 | 531346 | 1 | Air filter | エアーフィルター |
| 6 | 551734 | 1 | Equipotential terminal | グラウンドピン |
| 7 | 1114-167087B | 4 | Rubber foot | ゴム足 |
| 8 | 1124-037173B | 1 | High voltage warning label | 高圧注意ラベル（BS) |
| 9 | 6111-006974C | 1 | Board holder | ボードホルダ |
| 10 | 6111-006992A | 1 | Input block enclosure | インプットボックス |
| 11 | 6111-007001A | 1 | Rear enclosure | リアエンクロージャ |
| 12 | 6111-007037A | 1 | Lower front enclosure | インプットベゼル（P）シルクズ |
| 13 | 6112-000345C | 1 | Battery pack guide | 電池パックガイド |
| 14 | 6112-013402 | 1 | Power supply unit insulation cover | パワーインシュレータ |
| 15 | 6112-014419 | 1 | Operation board bracket | オペレーションホルダ |
| 16 | 6112-016168C | 1 | Recorder guide | レコーダガイド |
| 17 | 6112-016177B | 1 | Rear chassis | リアシャーシ |
| 18 | 6112-016676A | 1 | Battery pack holder | 電池パックホルダ |
| 19 | 6112-016711A | 1 | Input block shield | インプットシールド |
| 20 | 6112-016756 | 1 | DPU SP board shield | DPUシールド |
| 21 | 6113-029152 | 1 | Recorder blank panel | レコーダカバー |
| 22 | 6113-029179A | 1 | REMOTE socket cover | リモートコネクタカバー |
| 23 | 6113-036055B | 1 | Alarm indicator top cover | アラームインジケータ |
| 24 | 6113-036064A | 2 | Dial | ロータリジョグダイアル |
| 25 | 6113-037125 | 1 | Speaker holder | スピーカホルダ |
| 26 | 6113-044376A | 1 | Nellcor SpO2 socket shield | ネルコアプラグシールド |
| 27 | 6113-044411B | 1 | Speaker bracket | スピーカシャーシ |
| 28 | 6113-044919 | 1 | NIBP elbow tube | NIBP用チューブ |
| 29 | 6113-044928A | 1 | NIBP socket tube | NIBP用ツインチューブ |
| 30 | 6113-045696 | 1 | Mother board shield | マザーシールド |
| 31 | 6114-002205B | 1 | Battery receptacle terminal 1 | 電池端子１ |
| 32 | 6114-002214A | 2 | Battery receptacle terminal 2 | 電池端子２ |
| 33 | 6114-073556B | 1 | Square key top cover | キートップ |
| 34 | 6114-074796 | 2 | Heat radiation sheet | 放熱シート |
| 35 | 6114-079853 | 1 | EMI gasket | アースバネ |
| 36 | 6114-096959A | 1 | Silicon tube (80 mm long) | シリコンチューブ3 x 5　L.80 |
| 37 | 6114-097004A | 2 | Silicon tube | シリコンチューブ3 x 5 |
| 38 | 6114-106619A | 2 | Touch screen gasket (long) | タッチパネルパッキン（L) |
| 39 | 6114-106628A | 2 | Touch screen gasket (short) | タッチパネルパッキン（S) |
| 40 | 6114-106789 | 2 | Dust protector (long) | ダストプロテクタ（L) |
| 41 | 6114-106798 | 2 | Dust protector (short) | ダストプロテクタ（S) |
| 42 | 6114-107217 | 3 | EMI gasket with 4 holes | ホルダアースバネ（４穴） |
| 43 | 6114-107877 | 2 | Alarm indicator packing | アラームインジケータパッキン |
| 44 | 6114-108181 | 1 | Round key top cover | キートップ　11 x 6 |
| 45 | 6114-108261 | 1 | Insulator | ベースホルダインシュレータ |

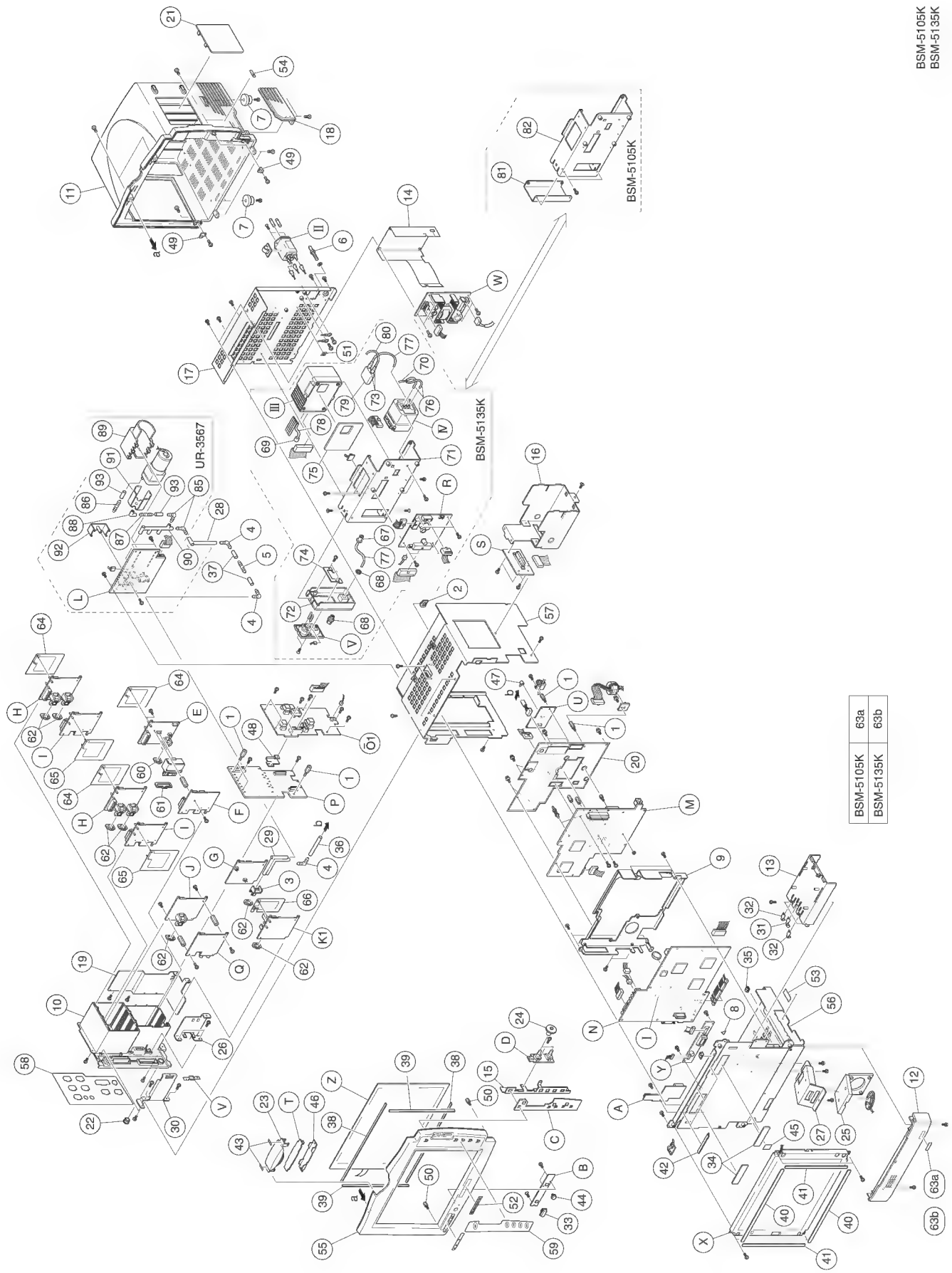

BSM-5105K
BSM-5135K
BSM-5105K
BSM-5135K
UR-3567
BSM-5105K
BSM-5135K
63a
63b

| Index | NK Code No. | Qty | Description | |
|---|---|---|---|---|
| 46 | 6114-114922B | 1 | Reflector | リフレクタ |
| 47 | 6114-116608 | 1 | Rubber elbow tube | L字チューブ |
| 48 | 6114-124395A | 1 | ECG ground plate | ECGグランドプレート |
| 49 | 6114-124475 | 3 | Screw support fitting | スクリューサポートプレート |
| 50 | 6114-124484 | 3 | Spacer bolt | 間隔ボルト |
| 51 | 6124-009937A | 1 | Ground label | グランドラベル |
| 52 | 6124-025928A | 1 | NIHON KOHDEN logo plastic panel | 社名プレート |
| 53 | 6124-032332 | 1 | Battery label | バッテリラベル |
| 54 | 6124-035908 | 1 | ZS label | ZSラベル |
| 55 | 6141-000807A | 1 | Front enclosure | フロントエンクロージャー |
| 56 | 6142-002982D | 1 | Main chassis | メインシャーシ |
| 57 | 6142-002991C | 1 | Chassis cover | シャーシカバー |
| 58 | 6123-014051A | 1 | Input plastic panel | インプットパネル |
| 59 | 6122-004679 | 1 | Operation plastic panel | オペレーションパネル |
| 60 | 6114-073191B | 1 | ECG/BP OUT socket packing | ECG/BGOUT5Pコネクタパッキン |
| 61 | 6114-073208A | 1 | ECG socket packing | ECG12Pコネクタ用パッキン |
| 62 | 6114-073217A | 4 | $SpO_2$/NIBP/Multi socket packing | 15Pコネクタ用パッキン |
| 63a | 6124-035846 | 1 | Model number label for BSM-5105 | 5105型式ラベル |
| 63b | 6124-035837 | 1 | Model number label for BSM-5135 | 5135型式ラベル |
| 64 | 6143-010249A | 3 | Shield sheet (left) | シールドシート（L) |
| 65 | 6143-010258A | 2 | Shield sheet (right) | シールドシート（R) |
| 66 | 6143-010267A | 1 | Shield sheet ($SpO_2$) | シールドシート（SpO2) |
| 67 | 302656 | 1 | Luer-lock fitting (female) | ルアフィッティング（メス） |
| 68 | 516505 | 1 | Tube joint | チューブジョイント |
| 69 | 612027A | 1 | Luer-lock fitting (male) | ルアフィッティング（オス） |
| 70 | 612036 | 1 | Tube junction fitting | ミニフィッティング |
| 71 | 6112-016212C | 1 | Multi gas unit chassis | AGユニットシャーシ |
| 72 | 6112-016685A | 1 | Multi gas unit side panel | AGエンクロージャー |
| 73 | 6114-103203B | 2 | Silicon tube | シリコンチューブ |
| 74 | 6114-116911 | 1 | Dryline receptacle support | パネルホルダ |
| 75 | 6114-117144 | 1 | Heat radiation sheet | 放熱シート |
| 76 | 6114-119748C | 2 | Urethane tube | ウレタンチューブ1.4 x 2.8L50 |
| 77 | 6114-119757C | 2 | Urethane tube | ウレタンチューブ1.4 x 2.8L100 |
| 78 | 6114-119775C | 1 | Urethane tube | ウレタンチューブ2.2 x 4.4L80 |
| 79 | 6114-122548 | 1 | Air tank | エアタンク |
| 80 | 6114-126606 | 2 | Urethan tube | ウレタンチューブ1.4 x 2.8L280 |
| 81 | 6112-016212C | 1 | Multi gas unit blank panel | AGユニットブランクパネル |
| 82 | 6114-124457 | 1 | Multi gas unit chassis | AGユニットシャーシ |
| | | | | |
| 85 | 531337 | 2 | Plastic elbow tube | L型継ぎ手 |
| 86 | 531346 | 1 | Air filter | エアフィルター |
| 87 | 531355 | 1 | Check valve | チェックバルブ |
| 88 | 1114-221509 | 1 | Elbow tube | チューブ |
| 89 | 6113-023844D | 1 | Pump holder | ポンプホルダ |
| 90 | 6113-037713A | 1 | Manifold tube | メインチューブ |
| 91 | 6114-073618 | 1 | Sponge | 防浸スポンジ |
| 92 | 6114-108412B | 1 | Valve holder | バルブホルダ |
| 93 | 6114-110222 | 2 | Silicon tube (20 mm long) | シリコンチューブL20 |


BSM-5105K
BSM-5135K
BSM-5105K
BSM-5135K
UR-3567
BSM-5105K 63a 63b
BSM-5135K 63b

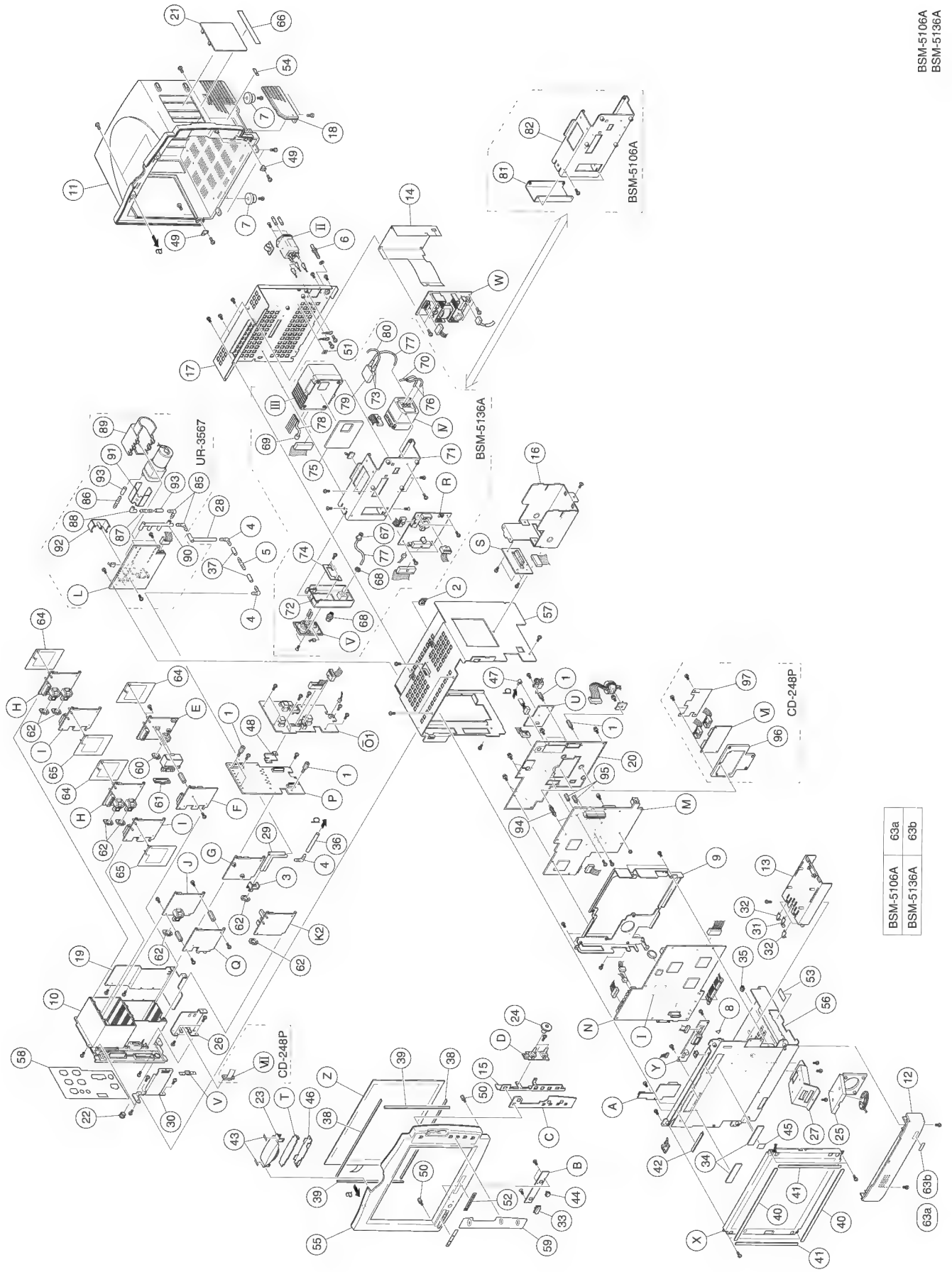
| Index | NK Code No. | Qty | Description | |
|---|---|---|---|---|
| A | UR-3541 | 1 | Connection board | コネクションボード |
| B | UR-35421 | 1 | Power SW board | パワースイッチボード |
| C | UR-35431 | 1 | Operation board | オペレーションボード |
| D | UR-3544 | 1 | Function Dial Board | ファンクションダイアル |
| E | UR-3546* | 1 | ECG RESP 1 board | ECG RESP1ボード |
| F | UR-3547* | 1 | ECG RESP 2 board | ECG RESP2ボード |
| G | UR-3548* | 1 | ECG RESP 3 board | ECG RESP3ボード |
| H | UR-3557 | 1 | MP1 board | MP1　ボード |
| I | UR-3558 | 1 | MP2 board | MP2　ボード |
| J | UR-3559 | 1 | MP3 board | MP3　ボード |
| K | UR-3561 | 1 | NK $SPO_2$ board | $SPO_2$　ボード |
| L | UR-3567 | 1 | NIBP Safety board | NIBP　安全ボード |
| M | UR-3673 | 1 | DPU SP board | DPU SPボード |
| N | UR-3586 | 1 | MAIN board | メインボード |
| O | UR-3675* | 1 | Mother PWR board | マザーPWRボード |
| P | UR-3674 | 1 | Mother CN board | マザーCNボード |
| Q | UR-3676 | 1 | TEMP board | TEMPボード |
| R | UR-3677 | 1 | AG IF board (BSM-5135A/K) | AG IFボード |
| S | UR-3678 | 1 | WS Mother board | WSメインボード |
| T | UR-3679 | 1 | Alarm SP board | アラームSPボード |
| U | UR-3698 | 1 | NIBP Measure board | NIBP Measured ボード |
| V | UR-3713 | 1 | Capacitor board | Capacitorボード |
| W | 550013C | 1 | Power supply unit | 電源ユニット |
| X | 575815A | 1 | LCD unit | LCDユニット |
| Y | 575824B | 1 | Inverter board | インバータ |
| Z | 575833A | 1 | Touch screen | タッチ画面 |
| I | 576565 | 1 | ATA card | ATAカード |
| II | 580676 | 1 | AC inlet socket with fuse drawer | ACインレット３EHG1-2 |
| | or the following combination | | | |
| | 550067 | 1 | AC inlet socket | ACインレット |
| | 550076 | 1 | Fuse drawer | ヒューズホルダ |
| III | 609824D | 1 | AION unit | AIONスタンダード |
| IV | 609833A | 1 | Oxygen transducer | $O_2$ センサー |
| V | 609842A | 1 | Dryline receptacle | ドライラインホルダー |

* ECG input block repair kit is required when one of the ECG RESPI, ECG, RESP2, ECG RESP3 and mother PWR boards has a failure. Refer to “Board Compatibility” in Section 10 “Internal Switch Setting and Board Compatibility”.


BSM-5105K
BSM-5135K
BSM-5105K
BSM-5135K
UR-3567
BSM-5105K 63a 63b
BSM-5135K 63b

# Bedside Monitor BSM-5106/5136

| Index | NK Code No. | Qty | Description | |
|---|---|---|---|---|
| 1 | 127907 | 5 | Spacer bolt | カンカクボルト |
| 2 | 132991 | 1 | Holder | ユツジホルダー |
| 3 | 515542B | 1 | NIBP socket | NIBP　ソケット |
| 4 | 531337 | 3 | Plastic elbow tube | L型継ぎ手 |
| 5 | 531346 | 1 | Air filter | エアーフィルター |
| 6 | 551734 | 1 | Equipotential terminal | グラウンドピン |
| 7 | 1114-167087B | 4 | Rubber foot | ゴム足 |
| 8 | 1124-037173B | 1 | High voltage warning label | 高圧注意ラベル（BS) |
| 9 | 6111-006974C | 1 | Board holder | ボードホルダ |
| 10 | 6111-006992A | 1 | Input block enclosure | インプットボックス |
| 11 | 6111-007001A | 1 | Rear enclosure | リアエンクロージャ |
| 12 | 6111-007037A | 1 | Lower front enclosure | インプットベゼル（P）シルクズ |
| 13 | 6112-000345C | 1 | Battery pack guide | 電池パックガイド |
| 14 | 6112-013402 | 1 | Power supply unit insulation cover | パワーインシュレータ |
| 15 | 6112-014419 | 1 | Operation board bracket | オペレーションホルダ |
| 16 | 6112-016168C | 1 | Recorder guide | レコーダガイド |
| 17 | 6112-016177B | 1 | Rear chassis | リアシャーシ |
| 18 | 6112-016676A | 1 | Battery pack holder | 電池パックホルダ |
| 19 | 6112-016711A | 1 | Input block shield | インプットシールド |
| 20 | 6112-016756 | 1 | DPU SP board shield | DPUシールド |
| 21 | 6113-029152 | 1 | Recorder blank panel | レコーダカバー |
| 22 | 6113-029179A | 1 | REMOTE socket cover | リモートコネクタカバー |
| 23 | 6113-036055B | 1 | Alarm indicator top cover | アラームインジケータ |
| 24 | 6113-036064A | 2 | Dial | ロータリジョグダイアル |
| 25 | 6113-037125 | 1 | Speaker holder | スピーカホルダ |
| 26 | 6113-044376A | 1 | Nellcor SpO2 socket shield | ネルコアプラグシールド |
| 27 | 6113-044411B | 1 | Speaker bracket | スピーカシャーシ |
| 28 | 6113-044919 | 1 | NIBP elbow tube | NIBP用チューブ |
| 29 | 6113-044928A | 1 | NIBP socket tube | NIBP用ツインチューブ |
| 30 | 6113-045696 | 1 | Mother board shield | マザーシールド |
| 31 | 6114-002205B | 1 | Battery receptacle terminal 1 | 電池端子１ |
| 32 | 6114-002214A | 2 | Battery receptacle terminal 2 | 電池端子２ |
| 33 | 6114-073556B | 1 | Square key top cover | キートップ |
| 34 | 6114-074796 | 2 | Heat radiation sheet | 放熱シート |
| 35 | 6114-079853 | 1 | EMI gasket | アースバネ |
| 36 | 6114-096959A | 1 | Silicon tube (80 mm long) | シリコンチューブ3 x 5　L.80 |
| 37 | 6114-097004A | 2 | Silicon tube | シリコンチューブ3 x 5 |
| 38 | 6114-106619A | 2 | Touch screen gasket (long) | タッチパネルパッキン（L) |
| 39 | 6114-106628A | 2 | Touch screen gasket (short) | タッチパネルパッキン（S) |
| 40 | 6114-106789 | 2 | Dust protector (long) | ダストプロテクタ（L) |
| 41 | 6114-106798 | 2 | Dust protector (short) | ダストプロテクタ（S) |
| 42 | 6114-107217 | 3 | EMI gasket with 4 holes | ホルダアースバネ（４穴） |
| 43 | 6114-107877 | 2 | Alarm indicator packing | アラームインジケータパッキン |
| 44 | 6114-108181 | 1 | Round key top cover | キートップ　11 x 6 |
| 45 | 6114-108261 | 1 | Insulator | ベースホルダインシュレータ |


BSM-5106A
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BSM-5136A
UR-3567
CD-248P
CD-248P
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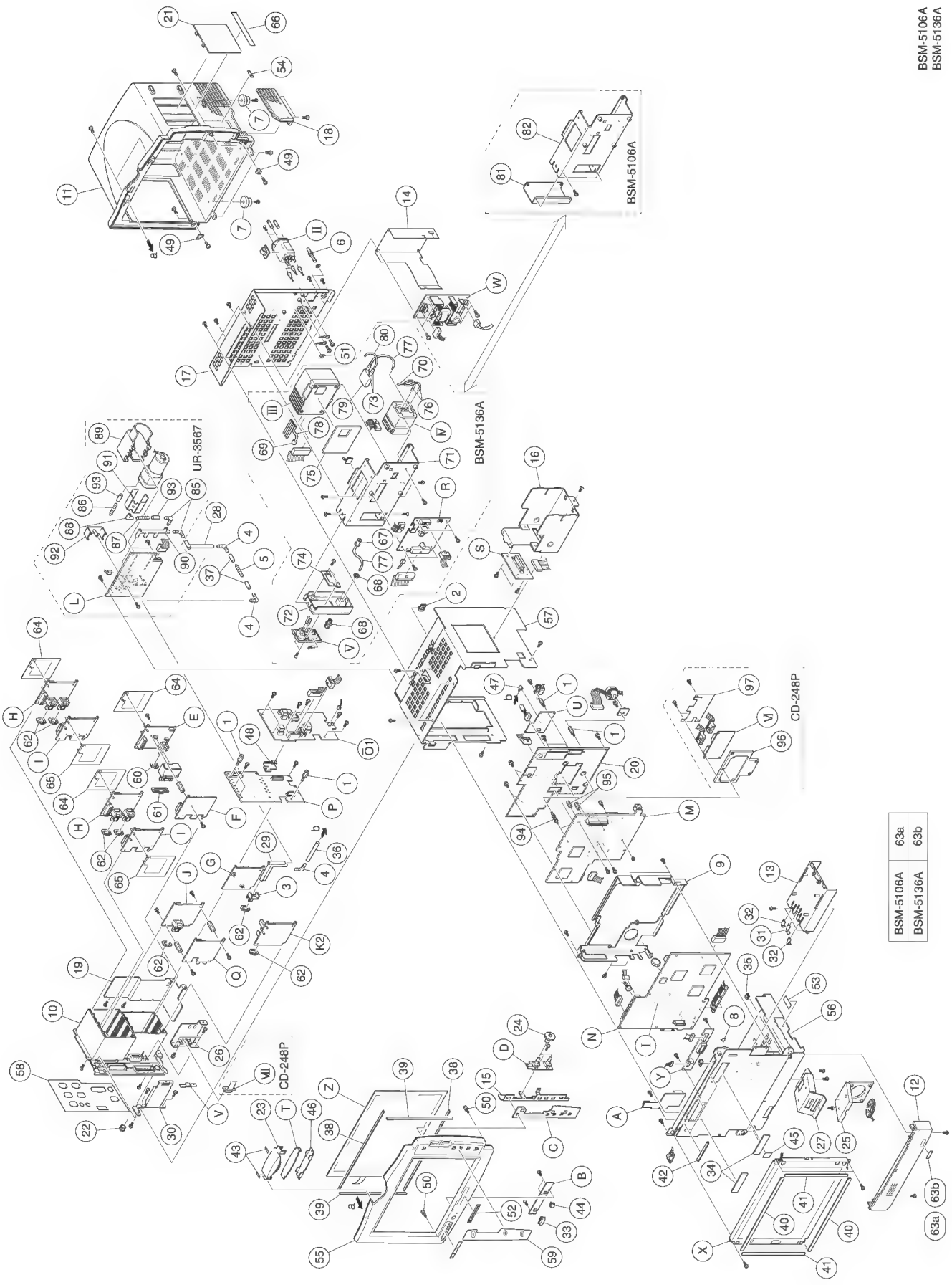
BSM-5136A

| Index | NK Code No. | Qty | Description | |
|---|---|---|---|---|
| 46 | 6114-114922B | 1 | Reflector | リフレクタ |
| 47 | 6114-116608 | 1 | Rubber elbow tube | L字チューブ |
| 48 | 6114-124395A | 1 | ECG ground plate | ECGグランドプレート |
| 49 | 6114-124475 | 3 | Screw support fitting | スクリューサポートプレート |
| 50 | 6114-124484 | 3 | Spacer bolt | 間隔ボルト |
| 51 | 6124-009937A | 1 | Ground label | グランドラベル |
| 52 | 6124-025928A | 1 | NIHON KOHDEN logo plastic panel | 社名プレート |
| 53 | 6124-032332 | 1 | Battery label | バッテリラベル |
| 54 | 6124-035908 | 1 | ZS label | ZSラベル |
| 55 | 6141-000807A | 1 | Front enclosure | フロントエンクロージャー |
| 56 | 6142-002982D | 1 | Main chassis | メインシャーシ |
| 57 | 6142-002991C | 1 | Chassis cover | シャーシカバー |
| 58 | 6123-014069A | 1 | Input plastic panel | インプットパネルNEL5 |
| 59 | 6122-004679 | 1 | Operation plastic panel | オペレーションパネル |
| 60 | 6114-073191B | 1 | ECG/BP OUT socket packing | ECG/BGOUT5Pコネクタパッキン |
| 61 | 6114-073208A | 1 | ECG socket packing | ECG12Pコネクタ用パッキン |
| 62 | 6114-073217A | 4 | $SpO_2$/NIBP/Multi socket packing | 15Pコネクタ用パッキン |
| 63a | 6124-035846 | 1 | Model number label for BSM-5106 | BSM-5106型式ラベル |
| 63b | 6124-035873 | 1 | Model number label for BSM-5136 | BSM-5136型式ラベル |
| 64 | 6143-010249A | 3 | Shield sheet (left) | シールドシート（L) |
| 65 | 6143-010258A | 2 | Shield sheet (right) | シールドシート（R) |
| 66 | 6143-010267A | 1 | CAUTION label | 注意ラベル |
| 67 | 302656 | 1 | Luer-lock fitting (female) | ルアフィッティング（メス） |
| 68 | 516505 | 1 | Tube joint | チューブジョイント |
| 69 | 612027A | 1 | Luer-lock fitting (male) | ルアフィッティング（オス） |
| 70 | 612036 | 1 | Tube junction fitting | ミニフィッティング |
| 71 | 6112-016212C | 1 | Multi gas unit chassis | AGユニットシャーシ |
| 72 | 6112-016685A | 1 | Multi gas unit side panel | AGエンクロージャー |
| 73 | 6114-103203B | 2 | Silicon tube | シリコンチューブ |
| 74 | 6114-116911 | 1 | Dryline receptacle support | パネルホルダ |
| 75 | 6114-117144 | 1 | Heat radiation sheet | 放熱シート |
| 76 | 6114-119748C | 2 | Urethane tube | ウレタンチューブ1.4 x 2.8L50 |
| 77 | 6114-119757C | 2 | Urethane tube | ウレタンチューブ1.4 x 2.8L100 |
| 78 | 6114-119775C | 1 | Urethane tube | ウレタンチューブ2.2 x 4.4L80 |
| 79 | 6114-122548 | 1 | Air tank | エアタンク |
| 80 | 6114-126606 | 2 | Urethan tube | ウレタンチューブ1.4 x 2.8L280 |
| 81 | 6112-016212C | 1 | Multi gas unit blank panel | AGユニットブランクパネル |
| 82 | 6114-124457 | 1 | Multi gas unit chassis | AGユニットシャーシ |
| | | | | |
| 85 | 531337 | 2 | Plastic elbow tube | L型継ぎ手 |
| 86 | 531346 | 1 | Air filter | エアフィルター |
| 87 | 531355 | 1 | Check valve | チェックバルブ |
| 88 | 1114-221509 | 1 | Elbow tube | チューブ |
| 89 | 6113-023844D | 1 | Pump holder | ポンプホルダ |
| 90 | 6113-037713A | 1 | Manifold tube | メインチューブ |
| 91 | 6114-073618 | 1 | Sponge | 防浸スポンジ |
| 92 | 6114-108412B | 1 | Valve holder | バルブホルダ |
| 93 | 6114-110222 | 2 | Silicon tube (20 mm long) | シリコンチューブL20 |


BSM-5106A
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BSM-5136A
UR-3567
CD-248P
CD-248P
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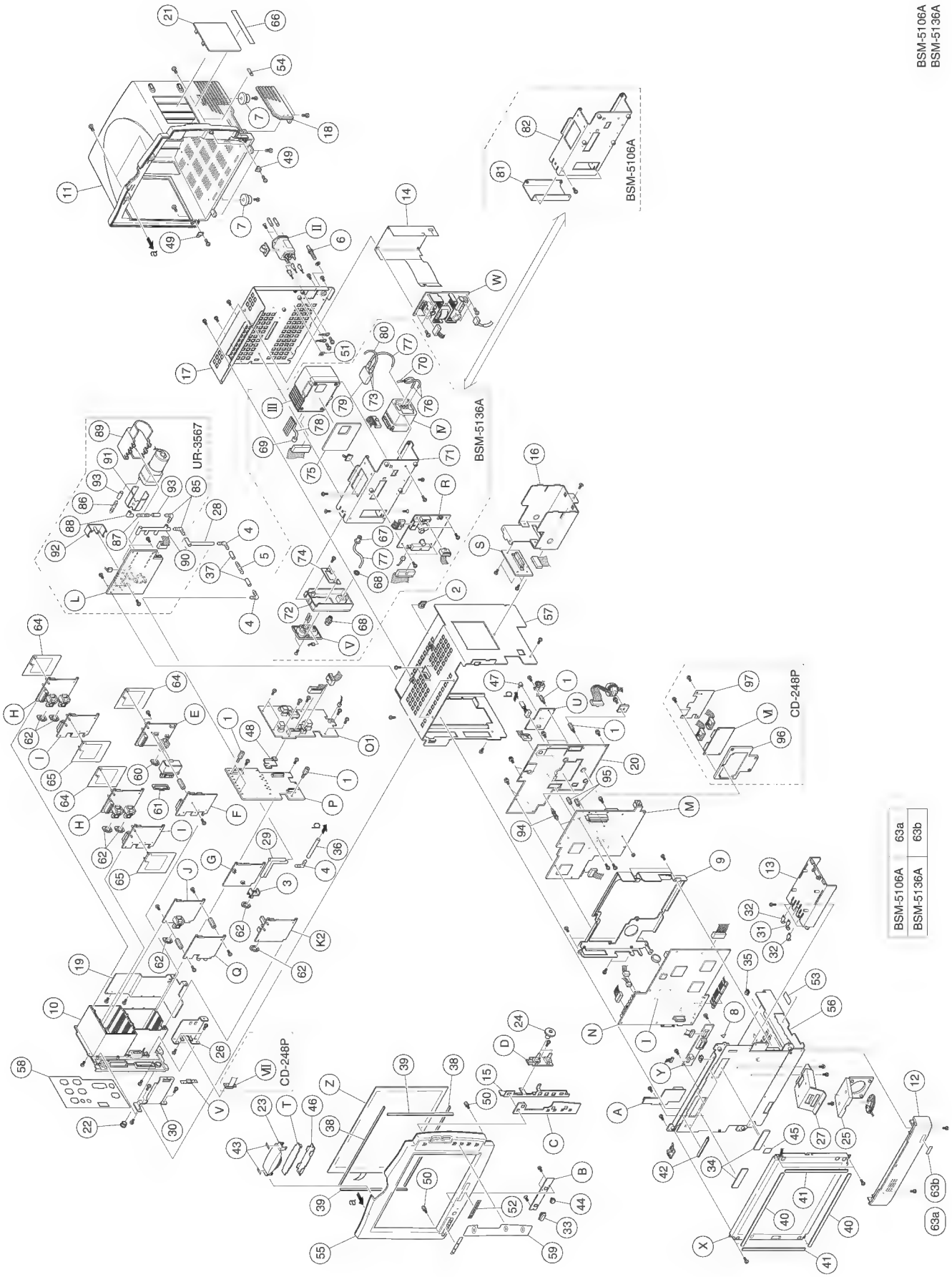
BSM-5136A
63a
63b

| Index | NK Code No. | Qty | Description | |
|---|---|---|---|---|
| 94 | 632077 | 2 | Plastic spacer | ミニダブルキバンポストL6.5 |
| 95 | 1114-148829 | 2 | Spacer bolt | 間隔ボルトL6.5 |
| 96 | 6113-045731 | 1 | Nellcor $SpO_2$ module adapter | ネルコアアダプタ |
| 97 | 6114-128997 | 1 | Nellcor $SpO_2$ module insulation sheet | ネルコアインシュレータ |
| | | | | |
| A | UR-3541 | 1 | Connection board | コネクションボード |
| B | UR-35421 | 1 | Power SW board | パワースイッチボード |
| C | UR-35431 | 1 | Operation board | オペレーションボード |
| D | UR-3544 | 1 | Function Dial board | ファンクションダイアル |
| E | UR-3546* | 1 | ECG RESP 1 board | ECG RESP1ボード |
| F | UR-3547* | 1 | ECG RESP 2 board | ECG RESP2ボード |
| G | UR-3548* | 1 | ECG RESP 3 board | ECG RESP3ボード |
| H | UR-3557 | 1 | MP1 board | MP1　ボード |
| I | UR-3558 | 1 | MP2 board | MP2　ボード |
| J | UR-3559 | 1 | MP3 board | MP3　ボード |
| L | UR-3567 | 1 | NIBP Safety board | NIBP　安全ボード |
| M | UR-3673 | 1 | DPU SP board | DPU SPボード |
| N | UR-3586 | 1 | MAIN board | メインボード |
| O | UR-3675* | 1 | Mother PWR board | マザーPWRボード |
| P | UR-3674 | 1 | Mother CN board | マザーCNボード |
| Q | UR-3676 | 1 | TEMP board | TEMPボード |
| R | UR-3677 | 1 | AG IF board (BSM-5136A) | AG IFボード |
| S | UR-3678 | 1 | WS Mother board | WSメインボード |
| T | UR-3679 | 1 | Alarm SP board | アラームSPボード |
| U | UR-3698 | 1 | NIBP Measure board | NIBP Measured　ボード |
| V | UR-3713 | 1 | Capacitor board | Capacitorボード |
| W | 550013C | 1 | Power supply unit | 電源ユニット |
| X | 575815A | 1 | LCD unit | LCDユニット |
| Y | 575824B | 1 | Inverter board | インバータ |
| Z | 575833A | 1 | Touch screen | タッチ画面 |
| I | 576565 | 1 | ATA card | ATAカード |
| II | 580676 | 1 | AC inlet socket with fuse drawer | ACインレット３EHG1-2 |
| | or the following combination | | | |
| | 550067 | 1 | AC inlet socket | ACインレット |
| | 550076 | 1 | Fuse drawer | ヒューズホルダ |
| III | 609824D | 1 | AION unit | AIONスタンダード |
| IV | 609833A | 1 | Oxygen transducer | O２センサー |
| V | 609842A | 1 | Dryline receptacle | ドライラインホルダー |
| VI | 634814 | 1 | Nellcor $SpO_2$ module | ネルコアSPO2モジュール |
| VII | 634823 | 1 | Nellcor $SpO_2$ module input cable | ネルコアSPO2ケーブル |

* ECG input block repair kit is required when one of the ECG RESP1, ECG RESP2, ECG RESP3 and mother PWR boards has a failure. Refer to “Board Compatibility” in Section 10 “Internal Switch Setting and Board Compatibility”.

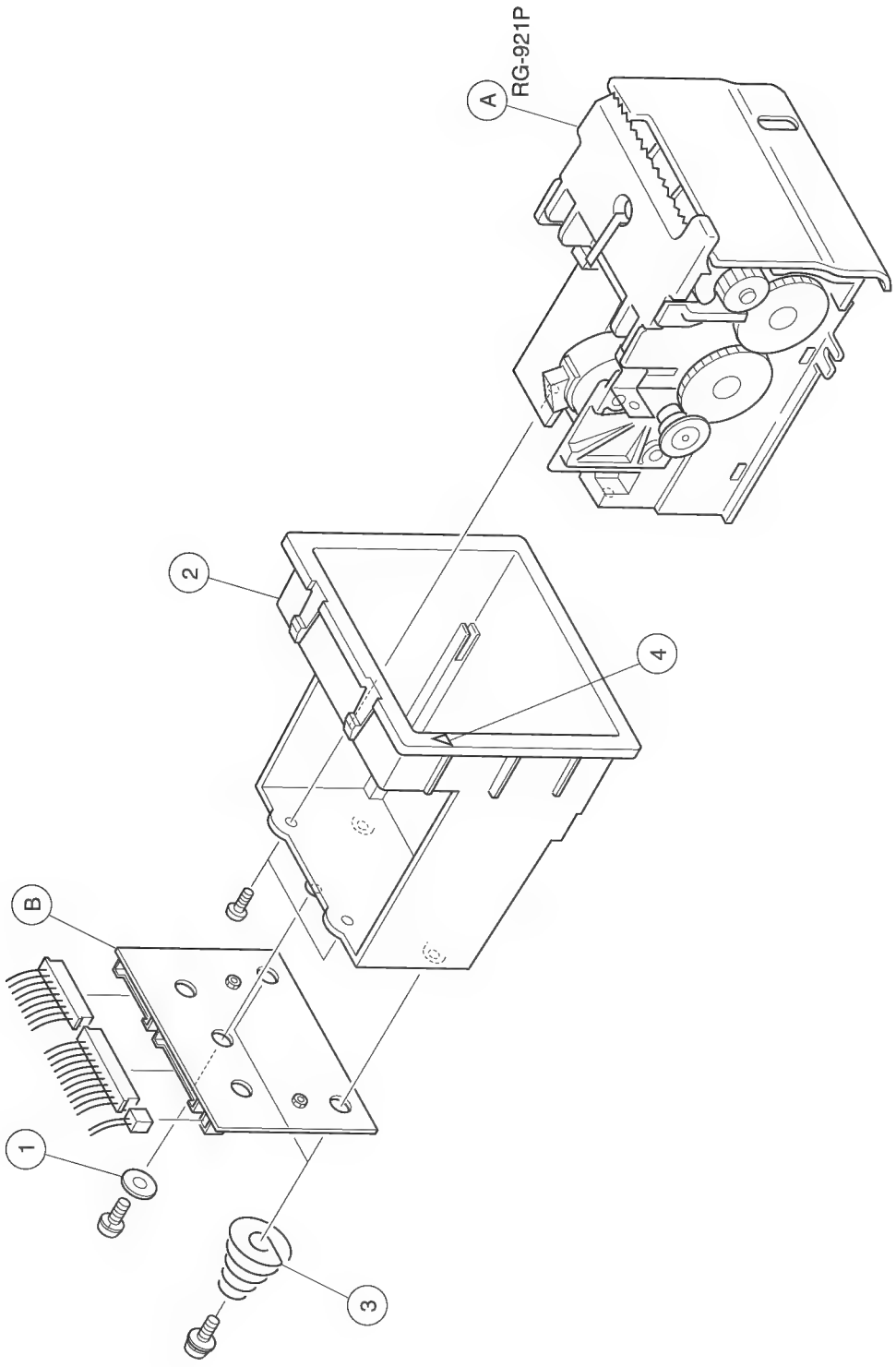

BSM-5106A
BSM-5136A
BSM-5106A
BSM-5136A
UR-3567
CD-248P
CD-248P
BSM-5106A 63a
BSM-5136A 63b

# WS-510P Recorder Module (Option)

| Index | NK Code No. | Qty | Description | |
|---|---|---|---|---|
| 1 | 579375 | | Washer | ウォッシャー |
| 2 | 6111-006983A | | Recorder enclosure | レコーダエンクロージャー |
| 3 | 6114-021104A | | Spring | トレイ押しバネ |
| 4 | 6114-120425 | | "Attention, consult operator's manual" symbol label | 三角マーク |
| A | RG-921P* | | Paper drive unit | ペーパードライブユニット |
| B | UR-3680 | | WS IF board | WS IF Board |

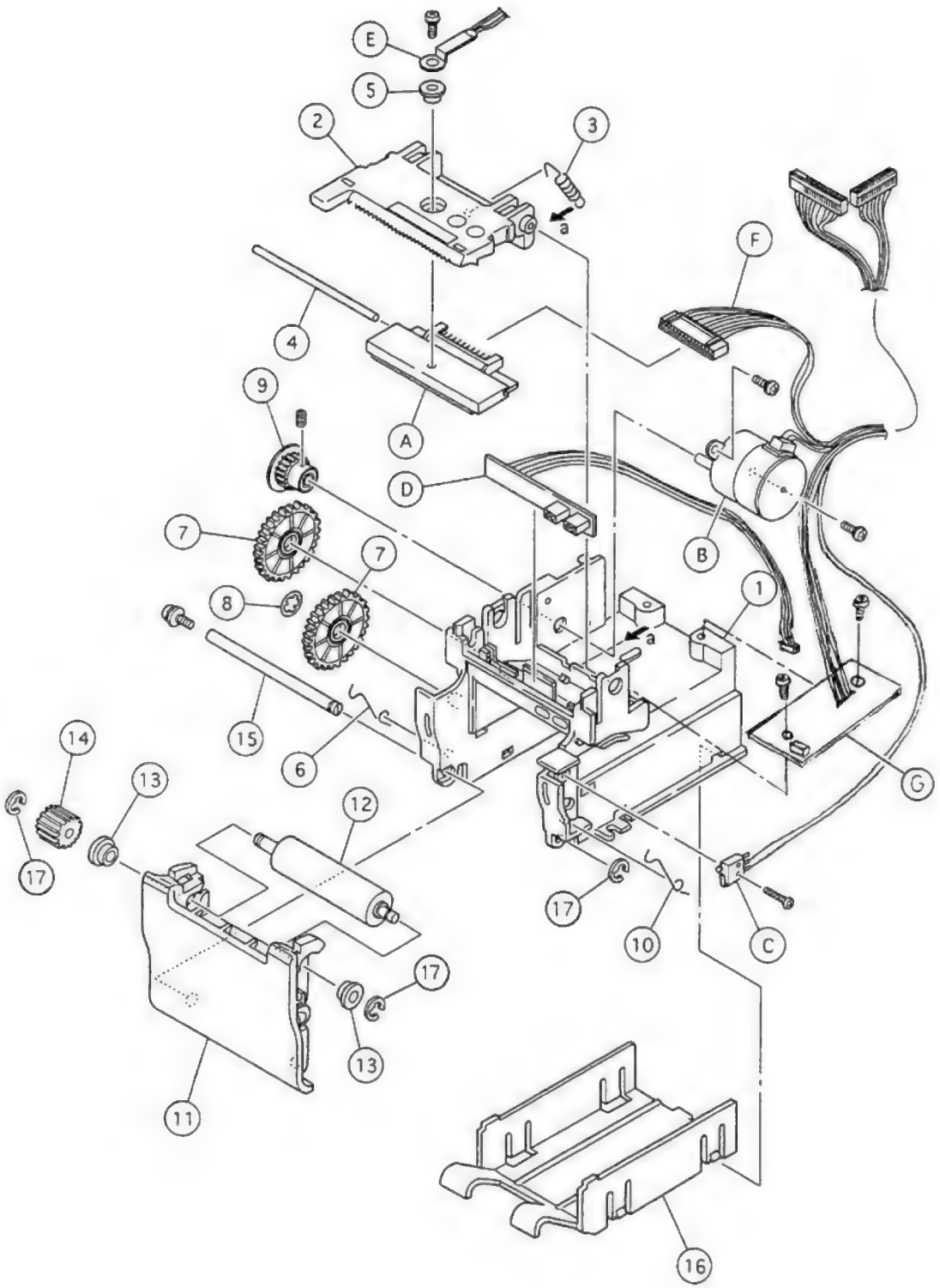
* See pages 8.16 to 8.17.

WS-510P



# RG-921P Paper Drive Unit for WS-510P Recorder Module

| Index | NK Code No. | Qty | Description | |
|---|---|---|---|---|
| 1 | 6111-002327E | 1 | Recorder chassis | キダイ |
| 2 | 6113-017726C | 1 | Head holder | ヘッドオサエ |
| 3 | 6114-067901A | 1 | Spring for head | K280 ヘッドカアツバネ |
| 4 | 6114-053132A | 1 | Shaft for head | サーマルヘッドジグ |
| 5 | 515284 | 1 | Bearing for head | B-F3-27 ベアリング |
| 6 | 6114-053141B | 1 | Spring for magazine door (left) | マガジンオシバネヒダリ |
| 7 | 6114-053177C | 2 | Idle gear | チュウケイハグルマ |
| 8 | 515506A | 1 | Stopper ring | CA-5 トメワ |
| 9 | 6114-053168C | 1 | Driving gear | モータハグルマ |
| 10 | 6114-053159B | 1 | Spring for magazine door (right) | マガジンオシバネミギ |
| 11 | 6112-008444C | 1 | Magazine door | オリタタミシヨウマガジン |
| 12 | 6114-053114C | 1 | Platen roller | プラテンローラ |
| 13 | 492503 | 2 | Bearing for magazine door | R-BRF0404 スリーブベアリング |
| 14 | 6114-059474B | 1 | Gear for platen roller | プラテンハグルマ |
| 15 | 6114-053186A | 1 | Shaft for magazine door | マガジンコテイジグ |
| 16 | 6113-023951A | 1 | Magazine tray | オリタタミシヨウソコイタ |
| 17 | 107002 | 3 | Retainer ring | E-32 リテナリング |
| | | | | |
| A | 445074 | 1 | Thermal array head | サーマルヘッド RJ048-8S81 |
| B | 445109B | 1 | Paper drive motor | 搬送用モータ PFC25-48T1 G (1/20)-01 |
| C | 448053 | 1 | Micro switch | マイクロスイッチ AV404461 |
| D | UR-3570 | 1 | Sensor board | センサボード |
| | 578447 | 2 | LED and photo transistor assembly | フォトセンサ |
| E | 525656A | 1 | Thermal array head grounding lead | ｻｰﾏﾙﾍｯﾄﾞ接地ｹｰﾌﾞﾙ |
| F | 449132A | 1 | Thermal array head connection cable | ｻｰﾏﾙﾍｯﾄﾞ接続ｹｰﾌﾞﾙ PHR-15 |
| G | UR-3571 | 1 | Sensor control board | ボリュームボード |




RG-921P

# Section 9 Connector Pin Assignment


MAIN Board ..... 9.1
CN006 (for Speaker) ..... 9.1
CN101 (for DPU SP board) ..... 9.2
CN102 (for Connection board) ..... 9.3
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CN105 (for power supply unit) ..... 9.4
CN106 (AUX socket) ..... 9.5
CN107 (for program or network card) ..... 9.6
CN108 (for Inverter board) ..... 9.7
CN109 (for ATA card [flash memory]) ..... 9.8
CN114 (REMOTE socket) ..... 9.9
CN121 (for WS Mother board) ..... 9.9
CN122 (for WS Mother board) ..... 9.10
CN123 (for WS Mother board) ..... 9.10
CN124 (for WS Mother board) ..... 9.10
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CNJ022 (for Mother PWR board) ..... 9.11
CNJ103 (for ECG RESP2 board) ..... 9.11
CNJ041 (for NIBP Measure board) ..... 9.12
CNJ042 (for NIBP Safety board) ..... 9.12
CN705 (for ZS-900P transmitter) ..... 9.13
CN2202 (for AG IF board) ..... 9.13
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CNJ305 (for ECG RESP1 board) ..... 9.14
CNJ303 (for ECG RESP2 board) ..... 9.14
CNJ304 (for ECG RESP2 board) ..... 9.15
CNJ301 (for ECG RESP3 board) ..... 9.15
CNJ302 (for ECG RESP3 board) ..... 9.16
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CNJ601 (for MP2 board) ..... 9.17
CNJ602 (for MP3 board) ..... 9.18
CNJ603 (for MP2 board) ..... 9.19
CNJ604 (for MP3 board) ..... 9.19

CNJ306 (for Mother PWR board) ..... 9.20
CNJ402 (for Mother PWR board) ..... 9.20
CNJ605 (for Mother PWR board) ..... 9.21
Mother PWR Board ..... 9.22
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CNJ306 (for Mother CN board) ..... 9.22
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CN101 (for Function Dial board) ..... 9.23
CN102 (for MAIN board) ..... 9.23
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CN101 (for MAIN board) ..... 9.24
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# MAIN Board

**CN 006 (for Speaker)**

| Pin Number | Signal Name | Signal Description |
|---|---|---|
| 1 | SND+ | Speaker positive |
| 2 | SND- | Speaker negative (Ground) |
| 3 | NC | Not connected |
| 4 | NC | Not connected |

**CN101 (for DPU SP board)**

| Signal Description | Signal Name | Pin Number | | Signal Name | Signal Description |
|---|---|---|---|---|---|
| Address bit 1 | A1 | 1B | 1A | A2 | Address bit 2 |
| Address bit 3 | A3 | 2B | 2A | A4 | Address bit 4 |
| Address bit 5 | A5 | 3B | 3A | A6 | Address bit 6 |
| Address bit 7 | A7 | 4B | 4A | E2 | Digital ground |
| Address bit 8 | A8 | 5B | 5A | A9 | Address bit 9 |
| Address bit 11 | A11 | 6B | 6A | A10 | Address bit 10 |
| Address bit 13 | A13 | 7B | 7A | A12 | Address bit 12 |
| Address bit 15 | A15 | 8B | 8A | A14 | Address bit 14 |
| Digital ground | E2 | 9B | 9A | A16 | Address bit 16 |
| Address bit 17 | A17 | 10B | 10A | A18 | Address bit 18 |
| Address bit 19 | A19 | 11B | 11A | A20 | Address bit 20 |
| Address bit 21 | A21 | 12B | 12A | A22 | Address bit 22 |
| Address bit 23 | A23 | 13B | 13A | E2 | Digital ground |
| Data bit 0 | D0 | 14B | 14A | D1 | Data bit 1 |
| Data bit 2 | D2 | 15B | 15A | D3 | Data bit 3 |
| Data bit 4 | D4 | 16B | 16A | D5 | Data bit 5 |
| Data bit 6 | D6 | 17B | 17A | D7 | Data bit 7 |
| Digital ground | E2 | 18B | 18A | D8 | Data bit 8 |
| Data bit 9 | D9 | 19B | 19A | D10 | Data bit 10 |
| Data bit 11 | D11 | 20B | 20A | D12 | Data bit 12 |
| Data bit 13 | D13 | 21B | 21A | D14 | Data bit 14 |
| Data bit 15 | D15 | 22B | 22A | E2 | Digital ground |
| Digital ground | E2 | 23B | 23A | RXW | Read/Write signal |
| Lower data strobe output | XLDS | 24B | 24A | XUDS | Upper data strobe output |
| Address strobe output | XAS | 25B | 25A | XIPL0 | Interrupt request input 0 |
| Interrupt request input 1 | XIPL1 | 26B | 26A | XIPL2 | Interrupt request input 2 |
| Data acknowledge input | XDTACK | 27B | 27A | XBERR | Bus error input |
| Function code output 0 | FC0 | 28B | 28A | FC1 | Function code output 1 |
| Function code output 2 | FC2 | 29B | 29A | XHALT | Halt input |
| System reset | XSYSRST | 30B | 30A | XAC | AC or DC recognition output |
| DPU reset | XRSTDPU | 31B | 31A | +15V | +15 V supply voltage |
| Bus request | XBR | 32B | 32A | XBG | Bus grant |
| Digital ground | E2 | 33B | 33A | +15V | +15 V supply voltage |
| DPU interrupt request input 2 | XDPUINT2 | 34B | 34A | XDPUINT1 | DPU interrupt request input 1 |
| +15 V supply voltage | +15V | 35B | 35A | E2 | Digital ground |
| +15 V supply voltage | +15V | 36B | 36A | KEY7 | KEY7 output |
| +5 V supply voltage | +5V | 37B | 37A | +3.3V | +3.3 V supply voltage |
| +5 V supply voltage | +5V | 38B | 38A | +3.3V | +3.3 V supply voltage |
| Digital ground | E2 | 39B | 39A | E2 | Digital ground |
| Power-on reset | XPWRRST | 40B | 40A | C20M_DPU | CPU clock pulse output |

**CN102 (for Connection board)**

| Signal Description | Signal Name | Pin Number | | Signal Name | Signal Description |
|---|---|---|---|---|---|
| Touch screen U signal | TOUCH_U | 1B | 1A | TOUCH_U | Touch screen U signal |
| Touch screen R signal | TOUCH_R | 2B | 2A | TOUCH_R | Touch screen R signal |
| Touch screen A signal | TOUCH_A | 3B | 3A | TOUCH_A | Touch screen A signal |
| Touch screen L signal | TOUCH_L | 4B | 4A | TOUCH_L | Touch screen L signal |
| Touch screen B signal | TOUCH_B | 5B | 5A | TOUCH_B | Touch screen B signal |
| Touch screen D signal | TOUCH_D | 6B | 6A | TOUCH_D | Touch screen D signal |
| Touch screen C signal | TOUCH_C | 7B | 7A | TOUCH_C | Touch screen C signal |
| Not connected | NC | 8B | 8A | NC | Not connected |
| Not connected | NC | 9B | 9A | NC | Not connected |
| Not connected | NC | 10B | 10A | NC | Not connected |
| Not connected | NC | 11B | 11A | NC | Not connected |
| Not connected | NC | 12B | 12A | NC | Not connected |
| Not connected | NC | 13B | 13A | NC | Not connected |
| Not connected | NC | 14B | 14A | NC | Not connected |
| Not connected | NC | 15B | 15A | NC | Not connected |
| Not connected | NC | 16B | 16A | NC | Not connected |
| Not connected | NC | 17B | 17A | NC | Not connected |
| Not connected | NC | 18B | 18A | NC | Not connected |
| LCD CK + signal | CKOP | 19B | 19A | CKOP | LCD CK + signal |
| LCD CK – signal | CKOM | 20B | 20A | CKOM | LCD CK – signal |
| LCD Y2 + signal | Y2P | 21B | 21A | Y2P | LCD Y2 + signal |
| LCD Y2 – signal | Y2M | 22B | 22A | Y2M | LCD Y2 – signal |
| LCD Y1 + signal | Y1P | 23B | 23A | Y1P | LCD Y1 + signal |
| LCD Y1 – signal | Y1M | 24B | 24A | Y1M | LCD Y1 – signal |
| LCD Y0 + signal | Y0P | 25B | 25A | Y0P | LCD Y0 + signal |
| LCD Y0 – signal | Y0M | 26B | 26A | Y0M | LCD Y0 – signal |
| Digital ground | E2 | 27B | 27A | E2 | Digital ground |
| Digital ground | E2 | 28B | 28A | E2 | Digital ground |
| +3.3 V supply voltage | +3.3V | 29B | 29A | +3.3V | +3.3 V supply voltage |
| +3.3 V supply voltage | +3.3V | 30B | 30A | +3.3V | +3.3 V supply voltage |

**CN103 (for Power SW board, Operation board and Alarm SP board)**

| Signal Description | Signal Name | Pin Number | | Signal Name | Signal Description |
|---|---|---|---|---|---|
| +15 V supply voltage | +15V | 1 | 2 | RED | Red LED cluster control |
| Yellow LED cluster control | YELLOW | 3 | 4 | GREEN | Green LED cluster control |
| Lower function dial A signal | JOGLA | 5 | 6 | JOGLB | Lower function dial B signal |
| Upper function dial A signal | JOGUA | 7 | 8 | JOGUB | Upper function dial B signal |
| +5 V supply voltage | +5V | 9 | 10 | E2 | Digital ground |
| Upper function dial LED | JOGLEDU | 11 | 12 | JOGLEDL | Lower function dial LED |
| SILENCE ALARMS key | KEY0 | 13 | 14 | KEY8 | NIBP INTERVAL key |
| NIBP START/STOP key | KEY7 | 15 | 16 | KEY1 | MENU key |
| HOME key | KEY2 | 17 | 18 | E2 | Digital ground |
| Alarm indicator power supply bus | +15RAW | 19 | 20 | KEY9 | Power switch |
| Power lamp | PWR_LED | 21 | 22 | STB_LED | AC power lamp |
| Battery power lamp | BAT1_LED | 23 | 24 | BAT2_LED | Battery charging lamp |
| Digital ground | E2 | 25 | 26 | E2 | Digital ground |
| Record key | KEY3 | 27 | 28 | PAP_LED | Out of paper lamp |
| +5 V supply voltage | +5V | 29 | 30 | E2 | Digital ground |

**CN105 (for power supply unit)**

| Pin Number | Signal Name | Signal Description |
|---|---|---|
| 1 | 15VOTS | +15 V supply voltage |
| 2 | 15VOTS | +15 V supply voltage |
| 3 | 15VOTS | +15 V supply voltage |
| 4 | GND | Ground |
| 5 | GND | Ground |
| 6 | GND | Ground |

**CN106 (AUX socket)**

| Signal Description | Signal Name | Pin Number | | Signal Name | Signal Description |
|---|---|---|---|---|---|
| Digital ground | E2 | 1 | 26 | E2 | Digital ground |
| Data Transmit | RSTXD | 2 | 27 | RSRXD | Data Receive |
| Request to Send | XRSRTS | 3 | 28 | XRSCTS | Clear to Send |
| Data Termination Ready | XRSDTR | 4 | 29 | XRSCD | Data Set Ready |
| Inhibit (+5 V supply voltage) | +5V | 5 | 30 | +5V | +5 V supply voltage |
| Digital ground | E2 | 6 | 31 | E2 | Digital ground |
| Not connected | NC | 7 | 32 | NC | Not connected |
| Inhibit (Reserve 01) | RESV01 | 8 | 33 | E2 | Digital ground |
| Inhibit (Reserve 02) | RESV02 | 9 | 34 | RESV03 | Inhibit (Reserve 03) |
| Inhibit (Reserve 04) | RESV04 | 10 | 35 | RESV05 | Inhibit (Reserve 05) |
| Digital ground | E2 | 11 | 36 | E2 | Digital ground |
| Inhibit (Reserve 06) | RESV06 | 12 | 37 | RESV07 | Inhibit (Reserve 07) |
| Digital ground | E2 | 13 | 38 | RESV08 | Inhibit (Reserve 08) |
| Inhibit (Reserve 09) | RESV09 | 14 | 39 | RESV10 | Inhibit (Reserve 10) |
| Inhibit (Reserve 11) | RESV11 | 15 | 40 | RESV12 | Inhibit (Reserve 12) |
| Inhibit (Reserve 13) | RESV13 | 16 | 41 | NC | Not connected |
| Inhibit (Reserve 14) | RESV14 | 17 | 42 | RESV15 | Inhibit (Reserve 15) |
| Digital ground | E2 | 18 | 43 | E2 | Digital ground |
| Digital red output | RED | 19 | 44 | GRET | Digital green output return |
| Digital red output return | RRET | 20 | 45 | GREEN | Digital green output |
| Digital blue output | BLUE | 21 | 46 | E2 | Digital ground |
| Digital blue output return | BRET | 22 | 47 | HSYNC | Horizontal synchronous signal |
| Digital ground | E2 | 23 | 48 | E2 | Digital ground |
| Digital ground | E2 | 24 | 49 | VSYNC | Vertical synchronous signal |
| Digital ground | E2 | 25 | 50 | E2 | Digital ground |

**CN107 (for program or network card)**

| Signal Description | Signal Name | Pin Number | | Signal Name | Signal Description |
|---|---|---|---|---|---|
| Digital ground | E2 | 1 | 2 | MEMD3 | Memory card data bit 3 |
| Memory card data bit 4 | MEMD4 | 3 | 4 | MEMD5 | Memory card data bit 5 |
| Memory card data bit 6 | MEMD6 | 5 | 6 | MEMD7 | Memory card data bit 7 |
| Memory card chip enable 1 | XMEMCE1 | 7 | 8 | MEMA10 | Memory card address bit 10 |
| Memory card output enable | XMOE | 9 | 10 | MEMA11 | Memory card address bit 11 |
| Memory card address bit 9 | MEMA9 | 11 | 12 | MEMA8 | Memory card address bit 8 |
| Memory card address bit 13 | MEMA13 | 13 | 14 | MEMA14 | Memory card address bit 14 |
| Memory card write enable | XMWE | 15 | 16 | XMCBSY | Memory card busy |
| +5 V supply voltage | +5V | 17 | 18 | +5V | +5 V supply voltage |
| Memory card address bit 16 | MEMA16 | 19 | 20 | MEMA15 | Memory card address bit 15 |
| Memory card address bit 12 | MEMA12 | 21 | 22 | MEMA7 | Memory card address bit 7 |
| Memory card address bit 6 | MEMA6 | 23 | 24 | MEMA5 | Memory card address bit 5 |
| Memory card address bit 4 | MEMA4 | 25 | 26 | MEMA3 | Memory card address bit 3 |
| Memory card address bit 2 | MEMA2 | 27 | 28 | MEMA1 | Memory card address bit 1 |
| Digital ground | E2 | 29 | 30 | MEMD0 | Memory card data bit 0 |
| Memory card data bit 1 | MEMD1 | 31 | 32 | MEMD2 | Memory card data bit 2 |
| Memory card write protect | MEMCWP | 33 | 34 | E2 | Digital ground |
| Digital ground | E2 | 35 | 36 | XMCD1 | Memory card detect bit 1 |
| Memory card data bit 11 | MEMD11 | 37 | 38 | MEMD12 | Memory card data bit 12 |
| Memory card data bit 13 | MEMD13 | 39 | 40 | MEMD14 | Memory card data bit 14 |
| Memory card data bit 15 | MEMD15 | 41 | 42 | XMEMCE2 | Memory card chip enable 2 |
| Not connected | NC | 43 | 44 | NC | Not connected |
| Not connected | NC | 45 | 46 | MEMA17 | Memory card address bit 17 |
| Memory card address bit 18 | MEMA18 | 47 | 48 | BANK0 | Memory bank select bit 0 |
| Memory bank select bit 1 | BANK1 | 49 | 50 | BANK2 | Memory bank select bit 2 |
| +5 V supply voltage | +5V | 51 | 52 | +5V | +5 V supply voltage |
| Memory bank select bit 3 | BANK3 | 53 | 54 | BANK4 | Memory bank select bit 4 |
| Memory bank select bit 5 | BANK5 | 55 | 56 | BANK6 | Memory bank select bit 6 |
| Not connected | NC | 57 | 58 | XMRST | Memory card reset |
| Not connected | NC | 59 | 60 | NC | Not connected |
| Attribute/common memory select | XREG | 61 | 62 | XMCBAT2 | Memory card battery status bit 2 |
| Memory card battery status bit 1 | XMCBAT1 | 63 | 64 | MEMD8 | Memory card data bit 8 |
| Memory card data bit 9 | MEMD9 | 65 | 66 | MEMD10 | Memory card data bit 10 |
| Memory card detect bit 2 | XMCD2 | 67 | 68 | E2 | Digital ground |

**CN108 (for Inverter board)**

| Pin Number | Signal Name | Signal Description |
|---|---|---|
| 1 | +15V | +15 V supply voltage for inverter |
| 2 | +15V | +15 V supply voltage for inverter |
| 3 | E2 | Digital ground |
| 4 | E2 | Digital ground |
| 5 | BCNT | Backlight ON/OFF |
| 6 | BCNT_PWM | Brightness control signal |
| 7 | NC | Not connected |
| 8 | NC | Not connected |
| 9 | NC | Not connected |
| 10 | NC | Not connected |

**CN109 (for ATA card [flash memory])**

| Signal Description | Signal Name | Pin Number | | Signal Name | Signal Description |
|---|---|---|---|---|---|
| Digital ground | E2 | 1 | 2 | ATAD3 | Memory card data bit 3 |
| Memory card data bit 4 | ATAD4 | 3 | 4 | ATAD5 | Memory card data bit 5 |
| Memory card data bit 6 | ATAD6 | 5 | 6 | ATAD7 | Memory card data bit 7 |
| Memory card chip enable 1 | XATACE1 | 7 | 8 | ATAA10 | Memory card address bit 10 |
| Memory card output enable | XAOE | 9 | 10 | ATAA11 | Memory card address bit 11 |
| Memory card address bit 9 | ATAA9 | 11 | 12 | ATAA8 | Memory card address bit 8 |
| Memory card address bit 13 | ATAA13 | 13 | 14 | ATAA14 | Memory card address bit 14 |
| Memory card write enable | XAWE | 15 | 16 | XABSY | Memory card busy |
| Supply voltage for memory card | +5V | 17 | 18 | +5V | Supply voltage for memory card |
| Memory card address bit 16 | ATAA16 | 19 | 20 | ATAA15 | Memory card address bit 15 |
| Memory card address bit 12 | ATAA12 | 21 | 22 | ATAA7 | Memory card address bit 7 |
| Memory card address bit 6 | ATAA6 | 23 | 24 | ATAA5 | Memory card address bit 5 |
| Memory card address bit 4 | ATAA4 | 25 | 26 | ATAA3 | Memory card address bit 3 |
| Memory card address bit 2 | ATAA2 | 27 | 28 | ATAA1 | Memory card address bit 1 |
| Digital ground | E2 | 29 | 30 | ATAD0 | Memory card data bit 0 |
| Memory card data bit 1 | ATAD1 | 31 | 32 | ATAD2 | Memory card data bit 2 |
| Memory card write protect | AWP | 33 | 34 | E2 | Digital ground |
| Digital ground | E2 | 35 | 36 | XACD1 | Memory card detect bit 1 |
| Memory card data bit 11 | ATAD11 | 37 | 38 | ATAD12 | Memory card data bit 12 |
| Memory card data bit 13 | ATAD13 | 39 | 40 | ATAD14 | Memory card data bit 14 |
| Memory card data bit 15 | ATAD15 | 41 | 42 | XATACE2 | Memory card chip enable 2 |
| Not connected | NC | 43 | 44 | NC | Not connected |
| Not connected | NC | 45 | 46 | ATAA17 | Memory card address bit 17 |
| Memory card address bit 18 | ATAA18 | 47 | 48 | ABNK0 | Memory bank select bit 0 |
| Memory bank select bit 1 | ABNK1 | 49 | 50 | ABNK2 | Memory bank select bit 2 |
| Supply voltage for memory card | +5V | 51 | 52 | +5V | Supply voltage for memory card |
| Memory bank select bit 3 | ABNK3 | 53 | 54 | ABNK4 | Memory bank select bit 4 |
| Memory bank select bit 5 | ABNK5 | 55 | 56 | ABNK6 | Memory bank select bit 6 |
| Not connected | NC | 57 | 58 | ARST | Memory card reset |
| Not connected | NC | 59 | 60 | NC | Not connected |
| Attribute/common memory select | XAREG | 61 | 62 | XABAT2 | Memory card battery status bit 2 |
| Memory card battery status bit 1 | XABAT1 | 63 | 64 | ATAD8 | Memory card data bit 8 |
| Memory card data bit 9 | ATAD9 | 65 | 66 | ATAD10 | Memory card data bit 10 |
| Memory card detect bit 2 | XACD2 | 67 | 68 | E2 | Digital ground |

**CN114 (REMOTE socket)**

| Pin Number | Signal Name | Signal Description |
|---|---|---|
| 1 | E2 | Digital ground |
| 2 | +5V | +5 V supply voltage |
| 3 | E2 | Digital ground |
| 4 | RESV_T | Inhibit (Reserve) |
| 5 | RESV_R | Inhibit (Reserve) |

**CN121 (for WS Mother board)**

| Pin Number | Signal Name | Signal Description |
|---|---|---|
| 1 | +24V | +24 V supply voltage for thermal array head |
| 2 | +24V | +24 V supply voltage for thermal array head |
| 3 | E24 | +24 V ground return |
| 4 | E24 | +24 V ground return |
| 5 | +5V | +5 V supply voltage |
| 6 | THM_5 | Thermal array head disable signal detected by thermistor |
| 7 | NTHENB | Thermal array head enable signal |
| 8 | NTHENB | Thermal array head enable signal |
| 9 | THCLK | Serial data transfer clock |
| 10 | NTHSTB | Thermal array head strobe signal |
| 11 | THDAT | Thermal array head serial data |
| 12 | E24 | +24 V ground return |
| 13 | E24 | +24 V ground return |
| 14 | +24V | +24 V supply voltage for thermal array head |
| 15 | +24V | +24 V supply voltage for thermal array head |

**CN122 (for WS Mothter board)**

| Pin Number | Signal Name | Signal Description |
|---|---|---|
| 1 | MA1 | Motor phase control A |
| 2 | MB1 | Motor phase control B |
| 3 | MA2 | Motor phase control A |
| 4 | MB2 | Motor phase control B |
| 5 | +3.3V | +3.3 V supply voltage |
| 6 | MOP_5 | Magazine condition detected signal |
| 7 | +5V | +5 V supply voltage |
| 8 | E2 | Digital ground |
| 9 | SNSON1 | Paper sensor enable signal |
| 10 | PEMP_5 | Paper detected signal |
| 11 | SNSON2 | Mark sensor enable signal |
| 12 | MK_5 | Mark detected signal |

**CN123 (for WS Mother borad)**

| Pin Number | Signal Name | Signal Description |
|---|---|---|
| 1 | E2 | Digital ground |
| 2 | E2 | Digital ground |

**CN124 (for WS Mother board)**

| Pin Number | Signal Name | Signal Description |
|---|---|---|
| 1 | SPREC-DET | Recorder connection status |
| 2 | E2 | Digital ground |

# DPU SP Board

### CN701 (for MAIN board)

Refer to "CN101 (for DPU SP board)" in the "MAIN board" section.

### CNJ022 (for Mother PWR board)

| Signal Description | Signal Name | Pin Number | | Signal Name | Signal Description |
|---|---|---|---|---|---|
| Synchronization signal | SYNC | A1 | B1 | VBUS | +15 V supply voltage |
| Analog ground | AGND | A2 | B2 | VBUS | +15 V supply voltage |
| $SpO_2$ digitized data | SPO2 | A3 | B3 | VBUS | +15 V supply voltage |
| +3.3 V supply voltage | +3.3V | A4 | B4 | TGND | Ground for +15 V |
| Nellcor serial data (TXD) | NEL_TXD | A5 | B5 | TGND | Ground for +15 V |
| Nellcor serial data (RXD) | NEL_RXD | A6 | B6 | TGND | Ground for +15 V |
| IBP waveform output | IBP_PWM | A7 | B7 | +8V | +8 V supply voltage for analog circuit |
| $SpO_2$ serial data (TXD) | SPO2_TXD | A8 | B8 | AECGOUT | ECG/RESP digitized data |
| $SpO_2$ serial data (RXD) | SPO2_RX | A9 | B9 | –8V | –8 V supply voltage for analog circuit |
| Digital ground | E2 | A10 | B10 | ECG_RXD | ECG serial data (RXD) |
| $SpO_2$ gate array clock | SAMPCK | A11 | B11 | ECG_TXD | ECG serial data (TXD) |
| Digital ground | E2 | A12 | B12 | E2 | Digital ground |
| 200 kHz clock | FCLK | A13 | B13 | COMMAND | 12 lead ECG command |
| Digital ground | E2 | A14 | B14 | ECGDATA | 12 lead ECG data |
| MP serial data (TXD)* | DPU_MP_TXD | A15 | B15 | +5VD | +5 V supply voltage |
| MP serial data (RXD)* | DPU_MP_RXD | A16 | B16 | CLK | 8 kHz clock |
| MP reset signal* | nMP_RST | A17 | B17 | XPM_DTECT | Pacing pulse detection |
| Digital ground | E2 | A18 | B18 | DPU_MP2_TXD | MP serial data (TXD)** |
| Life frequency | ACPICUP | A19 | B19 | DPU_MP2_RXD | MP serial data (RXD)** |
| Analog ground | AGND | A20 | B20 | nMP2_Rst | MP reset signal** |

* First group of the MP1, MP2 and TEMP boards. Refer to "Board/Unit Connection Diagram" in Section1.

* Second group of the MP1, MP2 and MP3 boars. Refer to "Board/Unit Connection Diagram" in Section 1.

### CNJ103 (for ECG RESP2 board)

| Pin Number | Signal Name | Signal Description |
|---|---|---|
| 1 | AGNDAOF | Analog ground |
| 2 | FBP | Blood pressure waveform output (BP) |
| 3 | FHT | Heart rate analog output (HT) |
| 4 | FECG | ECG waveform output |

**CNJ041 (for NIBP Measure board)**

| Pin Number | Signal Name | Signal Description |
|---|---|---|
| 1 | PRESS | Cuff pressure output |
| 2 | PULSE | Pulse complex output |
| 3 | AGND | Analog ground |
| 4 | AGND | Analog ground |
| 5 | — | Protection pin against erroneous connection |
| 6 | INST | Pulse complex baseline recovery |
| 7 | +5V | +5 V supply voltage |
| 8 | −5V | −5 V supply voltage |
| 9 | +8V | +8 V supply voltage |
| 10 | −8V | −8 V supply voltage |

**CNJ042 (for NIBP Safety board)**

| Signal Description | Signal Name | Pin Number | | Signal Name | Signal Description |
|---|---|---|---|---|---|
| Safety circuit cuff pressure | SPRESS | A1 | B1 | PUMP | Pump control |
| +5 V supply voltage | +5VD | A2 | B2 | BRAKE | Pump brake |
| +5 V supply voltage | +5VD | A3 | B3 | VALVE1 | Valve1 control |
| Digital ground | E2 | A4 | B4 | VALVE2 | Valve2 control |
| +8 V supply voltage | +8V | A5 | B5 | HW_ERR | Safety circuit abnormal |
| Digital ground | E2 | A6 | B6 | CANCEL | Safety circuit |
| Digital ground | E2 | A7 | B7 | INT | Periodic measurement interval |
| Analog ground | AGND | A8 | B8 | CUFF0 | Measurement mode 0 |
| Analog ground | AGND | A9 | B9 | CUFF1 | Measurement mode 1 |
| +6 V ground | EP | A10 | B10 | IEC_ERR | IEC standard error |
| +6 V ground | EP | A11 | B11 | XNIBPSS | Measure/Stop |
| +6 V ground | EP | A12 | B12 | INTRET | INT return |
| +6 V ground | EP | A13 | B13 | CANCELRET | CANCEL return |
| +6 V supply voltage | +6V | A14 | B14 | CUFF1RET | CUFF1 return |
| +6 V supply voltage | +6V | A15 | B15 | CUFF0RET | CUFF0 return |
| +6 V supply voltage | +6V | A16 | B16 | NIBPSSRET | XNIBPSS return |
| +6 V supply voltage | +6V | A17 | B17 | ZEROEND | Zeroing completion |

**CN705 (for ZS-900P transmitter)**

| Pin Number | Signal Name | Signal Description |
|---|---|---|
| 1 | ECG_DA | ECG analog output |
| 2 | AGND | Analog ground |
| 3 | E2 | Digital ground |
| 4 | +5VD | +5V supply voltage |
| 5 | ZB_RST | Reset signal |
| 6 | ZB_CLK | Clock |
| 7 | ZB_RXD | Serial data (RXD) |
| 8 | ZB_TXD | Serial data (TXD) |

**CN2202 (for AG IF board)**

| Pin Number | Signal Name | Signal Description |
|---|---|---|
| 1 | VBUS | +15V supply voltage |
| 2 | VBUS | +15V supply voltage |
| 3 | VBUS | +15V supply voltage |
| 4 | E2 | Digital ground |
| 5 | E2 | Digital ground |
| 6 | E2 | Digital ground |
| 7 | AGVERUP | AG IF mode select signal |
| 8 | RXD | Received gas data |
| 9 | TXD | Control signal |
| 10 | XAGRST | AG IF reset signal |

# Mother CN Board

### CNJ305 (for ECG RESP1 board)

| Signal Description | Signal Name | Pin Number | | Signal Name | Signal Description |
|---|---|---|---|---|---|
| Protective earth | PGND | A1 | B1 | PGND | Protective earth |
| Protective earth | PGND | A2 | B2 | PGND | Protective earth |
| Protective earth | PGND | A3 | B3 | PGND | Protective earth |
| Protective earth | PGND | A4 | B4 | PGND | Protective earth |
| Protective earth | PGND | A5 | B5 | PGND | Protective earth |
| Protective earth | PGND | A6 | B6 | PGND | Protective earth |
| Protective earth | PGND | A7 | B7 | PGND | Protective earth |
| Protective earth | PGND | A8 | B8 | PGND | Protective earth |
| Protective earth | PGND | A9 | B9 | PGND | Protective earth |
| Protective earth | PGND | A10 | B10 | PGND | Protective earth |

### CNJ303 (for ECG RESP2 board)

| Signal Description | Signal Name | Pin Number | | Signal Name | Signal Description |
|---|---|---|---|---|---|
| Respiration circuit ground | ER | A1 | B1 | RESP | Respiration digitized data |
| Respiration circuit ground | ER | A2 | B2 | AGNDF | Analog ground |
| Analog ground | AGNDF | A3 | B3 | Z0 | Respiration measure |
| Analog ground | AGNDF | A4 | B4 | RINST | Respiration baseline recovery |
| +8 V supply voltage for analog circuit | +8VF | A5 | B5 | RSEL | Respiration electrode select |
| −8 V supply voltage for analog circuit | −8VF | A6 | B6 | PWMI | Lead I time constant adjust |
| +2.5 V reference voltage | AVR+ | A7 | B7 | PWMII | Lead II time constant adjust |
| −2.5 V reference voltage | AVR− | A8 | B8 | PWM[01] | Lead C1 time constant adjust |
| +2.5 V supply voltage | +2.5VF | A9 | B9 | PWM[02] | Lead C2 time constant adjust |
| −2.5 V supply voltage | −2.5VF | A10 | B10 | PWM[03] | Lead C3 time constant adjust |
| +8 V supply voltage for respiration | +8VFR | A11 | B11 | PWM[04] | Lead C4 time constant adjust |
| −8 V supply voltage for respiration | −8VFR | A12 | B12 | PWM[05] | Lead C5 time constant adjust |
| Carrier frequency for respiration | 125kHz | A13 | B13 | PWM[06] | Lead C6 time constant adjust |
| +3 V supply voltage for analog circuit | +VAN | A14 | B14 | CAL | Calibration control |
| −3 V supply voltage for analog circuit | −VAN | A15 | B15 | XDC_CHECK | 12 lead electrode polarization voltage detection |

### CNJ304 (for ECG RESP2 board)

| Signal Description | Signal Name | Pin Number | | Signal Name | Signal Description |
|---|---|---|---|---|---|
| Polarity detection electrode select | MUX[0] | A1 | B1 | BII | Lead II ECG |
| Polarity detection electrode select | MUX[1] | A2 | B2 | BC1 | Lead C1 ECG |
| Polarity detection electrode select | MUX[2] | A3 | B3 | BC2 | Lead C2 ECG |
| Polarity detection electrode select | MUX[3] | A4 | B4 | BC3 | Lead C3 ECG |
| Polarity detection electrode select | MUX[4] | A5 | B5 | BC4 | Lead C4 ECG |
| Polarity detection electrode select | MUX[5] | A6 | B6 | BC5 | Lead C5 ECG |
| Resolution control clock | 1MS | A7 | B7 | BC6 | Lead C6 ECG |
| Pacing pulse detection | PM_DETCT | A8 | B8 | AGNDF | Analog ground |
| BR-903P detection | 3L | A9 | B9 | AGNDF | Analog ground |
| BR-906P detection | 36L | A10 | B10 | AGNDF | Analog ground |
| ECG output lead select 0 | AECGSEL0 | A11 | B11 | AGNDF | Analog ground |
| ECG output lead select 1 | AECGSEL1 | A12 | B12 | AGNDF | Analog ground |
| ECG output lead select 2 | AECGSEL2 | A13 | B13 | FBSEL0 | Feedback electrode select 0 |
| ECG output lead select 3 | AECGSEL3 | A14 | B14 | FBSEL1 | Feedback electrode select 1 |
| Lead I ECG | BI | A15 | B15 | AECG | ECG digitized data |

### CNJ301 (for ECG RESP3 board)

| Signal Description | Signal Name | Pin Number | | Signal Name | Signal Description |
|---|---|---|---|---|---|
| Analog ground | AGNDF | A1 | B1 | F_TXD | Status (TXD) signal |
| Analog ground | AGNDF | A2 | B2 | F_RXD | Status (RXD) signal |
| Analog ground | AGNDF | A3 | B3 | Z0 | Respiration measure signal |
| Analog ground | AGNDF | A4 | B4 | RINST | Respiration baseline recovery signal |
| +8 V supply voltage for analog circuit | +8VF | A5 | B5 | RSEL | Respiration electrode select signal |
| –8 V supply voltage for analog circuit | –8VF | A6 | B6 | PWMI | Lead I time constant adjust signal |
| +2.5 V reference voltage | AVRF+ | A7 | B7 | PWMII | Lead II time constant adjust signal |
| –2.5 V reference voltage | AVRF– | A8 | B8 | PWM[01] | Lead C1 time constant adjust signal |
| +2.5 V supply voltage | +2.5VF | A9 | B9 | PWM[02] | Lead C2 time constant adjust signal |
| –2.5 V supply voltage | –2.5VF | A10 | B10 | PWM[03] | Lead C3 time constant adjust signal |
| Command data | CMD | A11 | B11 | PWM[04] | Lead C4 time constant adjust signal |
| 12 lead ECG data | SDAT | A12 | B12 | PWM[05] | Lead C5 time constant adjust signal |
| Carrier frequency for respiration | 125kHz | A13 | B13 | PWM[06] | Lead C6 time constant adjust signal |
| Floating control clock | F_ECLK | A14 | B14 | CAL | Calibration control signal |
| Floating synchronization | F_ESYNC | A15 | B15 | XDC_CHECK | 12 lead electrode polarization voltage detection |

### CNJ302 (for ECG RESP3 board)

| Signal Description | Signal Name | Pin Number | | Signal Name | Signal Description |
|---|---|---|---|---|---|
| Polarity detection electrode select | MUX[0] | A1 | B1 | BII | Lead II ECG |
| Polarity detection electrode select | MUX[1] | A2 | B2 | BC1 | Lead C1 ECG |
| Polarity detection electrode select | MUX[2] | A3 | B3 | BC2 | Lead C2 ECG |
| Polarity detection electrode select | MUX[3] | A4 | B4 | BC3 | Lead C3 ECG |
| Polarity detection electrode select | MUX[4] | A5 | B5 | BC4 | Lead C4 ECG |
| Polarity detection electrode select | MUX[5] | A6 | B6 | BC5 | Lead C5 ECG |
| Resolution control clock | 1MS | A7 | B7 | BC6 | Lead C6 ECG |
| Pacing pulse detection | PM_DETCT | A8 | B8 | PWRCONT | Supply voltage control |
| BR-903P detection | 3L | A9 | B9 | F_AECGOUT | Floating ECG digitized data |
| BR-906P detection | 36L | A10 | B10 | AGNDF | Analog ground |
| ECG output lead select 0 | AECGSEL0 | A11 | B11 | AGNDF | Analog ground |
| ECG output lead select 1 | AECGSEL1 | A12 | B12 | 8kHz | A to D timing synchronous clock |
| ECG output lead select 2 | AECGSEL2 | A13 | B13 | FBSEL0 | Feedback electrode select 0 |
| ECG output lead select 3 | AECGSEL3 | A14 | B14 | FBSEL1 | Feedback electrode select 1 |
| Lead I ECG | BI | A15 | B15 | AECG | ECG digitized data |

### CNJ401 (for NK $SpO_2$ board)

| Signal Description | Signal Name | Pin Number | | Signal Name | Signal Description |
|---|---|---|---|---|---|
| +10 V supply voltage for analog circuit | +10UF | A1 | B1 | EF | Floating ground |
| +10 V supply voltage for analog circuit | +10UF | A2 | B2 | F_SPO2 | $SpO_2$ digitized multiplexed data |
| Ground for LED | LEF | A3 | B3 | EF | Floating ground |
| Floating ground | EF | A4 | B4 | NC | Not connected |
| +2.5 V supply voltage for analog circuit | +2.5F | A5 | B5 | EF | Floating ground |
| Ground for LED | LEF | A6 | B6 | F_SCLK | Floating control clock |
| +5 V supply voltage for digital circuit | +5DF | A7 | B7 | EF | Floating ground |
| +5 V supply voltage for digital circuit | +5DF | A8 | B8 | F_SSYNC | Floating synchronization |
| −2.5 V supply voltage for analog circuit | −2.5F | A9 | B9 | EF | Floating ground |
| +5 V supply voltage for analog circuit | +5F | A10 | B10 | F_SPO2_RXD | Floating $SpO_2$ control (output) |
| +5 V supply voltage for analog circuit | +5F | A11 | B11 | EF | Floating ground |
| Floating ground | EF | A12 | B12 | F_SAMPCK | Floating gate array clock |
| −5 V supply voltage for analog circuit | −5F | A13 | B13 | EF | Floating ground |
| −5 V supply voltage for analog circuit | −5F | A14 | B14 | F_SPO2_TXD | Floating $SpO_2$ control (input) |
| Floating ground | EF | A15 | B15 | EF | Floating ground |

**CNJ601 (for MP2 board)**

| Signal Description | Signal Name | Pin Number | | Signal Name | Signal Description |
|---|---|---|---|---|---|
| Floating analog ground | AEF | A1 | B1 | DEF | Floating digital ground |
| +5 V for floating analog circuit (DPU1) | +5VAF1 | A2 | B2 | +6VDF1 | +6 V for floating digital circuit (DPU1) |
| MP3 BP positive output (DPU1) | DPU1_BP+_3 | A3 | B3 | MP_DPU1_RXD | MP serial data (RXD) (DPU1) |
| MP3 BP negative output (DPU1) | DPU1_BP-_3 | A4 | B4 | MP_DPU1_TXD | MP serial data (TXD) (DPU1) |
| −5 V for floating analog circuit (DPU1) | −5VAF1 | A5 | B5 | MP_DPU1_nRST | Reset signal (DPU1) |
| Reference voltage (DPU1) | DPU1_VREF | A6 | B6 | DPU1_CO2_RXD_3 | MP3 CO2 serial data (TXD) (DPU1) |
| +2.5 V exciter voltage (DPU1) | DPU1_EXT25 | A7 | B7 | DPU1_CO2_TXD_3 | MP3 CO2 serial data (RXD) (DPU1) |
| −0.5 V exciter voltage (DPU1) | DPU1_EXT05 | A8 | B8 | DPU1_ROM_CLK_3 | MP3 EEPROM clock (DPU1) |
| +5 V for floating analog circuit (DPU1) | +5VAF1 | A9 | B9 | DPU1_ROM_DATA_3 | MP3 EEPROM data (DPU1) |
| MP3 status (DPU1) | DPU1_MP3_SL | A10 | B10 | DPU1_SW_3 | IBP key status (DPU1) |
| Floating analog ground | AEF | A11 | B11 | F_IBP_PWM | BP PWM output (DPU1) |
| MP3 common input (DPU1) | DPU1_COM1_3 | A12 | B12 | DPU1_EXT_CTRL0_3 | MP3 exciter setting (DPU1) |
| MP3 common input (DPU1) | DPU1_COM2_3 | A13 | B13 | DPU1_EXT_CTRL1_3 | MP3 exciter setting (DPU1) |
| ROM write in microprocessor (DPU1) | DPU1_ROM_W_SL | A14 | B14 | +6VDF1 | +6 V for floating digital circuit (DPU1) |
| MP3 connection recognition (DPU1) | - | A15 | B15 | DEF | Floating digital ground |

**CNJ602 (for MP3 board)**

| Signal Description | Signal Name | Pin Number | | Signal Name | Signal Description |
|---|---|---|---|---|---|
| Floating analog ground | AEF | A1 | B1 | DEF | Floating digital ground |
| +5 V for floating analog circuit (DPU1) | +5VAF1 | A2 | B2 | +6VDF1 | +6 V for floating digital circuit (DPU1) |
| MP3 BP positive input (DPU1) | DPU1_BP+_3 | A3 | B3 | DEF | Floating digital ground |
| MP3 BP negative input (DPU1) | DPU1_BP-_3 | A4 | B4 | DEF | Floating digital ground |
| –5 V for floating analog circuit (DPU1) | –5VAF1 | A5 | B5 | DEF | Floating digital ground |
| Reference voltage (DPU1) | DPU1_VREF | A6 | B6 | DPU1_CO2_RXD_3 | MP3 CO2 serial data (RXD) (DPU1) |
| +2.5 V exciter voltage (DPU1) | DPU1_EXT25 | A7 | B7 | DPU1_CO2_TXD_3 | MP3 CO2 serial data (TXD) (DPU1) |
| –2.5 V exciter voltage (DPU1) | DPU1_EXT05 | A8 | B8 | DPU1_ROM_CLK_3 | MP3 EEPROM clock (DPU1) |
| +5 V floating for analog circuit | +5VAF1 | A9 | B9 | DPU1_ROM_DATA_3 | MP3 EEPROM data (DPU1) |
| MP3 status (DPU1) | DPU1_MP3_SL | A10 | B10 | DPU1_SW_3 | IBP key status (DPU1) |
| Floating analog ground | AEF | A11 | B11 | DEF | Floating digital ground |
| MP3 common input (DPU1) | DPU1_COM1_3 | A12 | B12 | DPU1_EXT_CTRL0_3 | MP3 exciter setting (DPU1) |
| MP3 common input (DPU1) | DPU1_COM2_3 | A13 | B13 | DPU1_EXT_CTRL1_3 | MP3 exciter setting (DPU1) |
| Floating analog ground (DPU1) | AEF | A14 | B14 | +6VDF1 | +6 V for floating digital circuit (DPU1) |
| MP3 connection recognition (DPU1) | - | A15 | B15 | DEF | Floating digital ground |

### CNJ603 (for MP2 board)

| Signal Description | Signal Name | Pin Number | | Signal Name | Signal Description |
|---|---|---|---|---|---|
| Floating analog ground | AEF | A1 | B1 | DEF | Floating digital ground |
| +5 V for floating analog circuit (DPU2) | +5VAF2 | A2 | B2 | +6VDF2 | +6 V for floating digital circuit (DPU2) |
| MP3 BP positive output (DPU2) | DPU2_BP+_3 | A3 | B3 | MP_DPU2_RXD | MP serial data (RXD) (DPU2) |
| MP3 BP negative output (DPU2) | DPU2_BP-_3 | A4 | B4 | MP_DPU2_TXD | MP serial data (TXD) (DPU2) |
| –5 V for floating analog circuit (DPU2) | –5VAF2 | A5 | B5 | MP_DPU2_nRST | Reset signal (DPU2) |
| Reference voltage (DPU2) | DPU2_VREF | A6 | B6 | DPU2_CO2_RXD_3 | MP3 CO2 serial data (TXD) (DPU2) |
| +2.5 V exciter voltage (DPU2) | DPU2_EXT25 | A7 | B7 | DPU2_CO2_TXD_3 | MP3 CO2 serial data (RXD) (DPU2) |
| –0.5 V exciter voltage (DPU2) | DPU2_EXT05 | A8 | B8 | DPU2_ROM_CLK_3 | MP3 EEPROM clock (DPU2) |
| +5 V for floating analog circuit (DPU2) | +5VAF2 | A9 | B9 | DPU2_ROM_DATA_3 | MP3 EEPROM data (DPU2) |
| MP3 status (DPU2) | DPU2_MP3_SL | A10 | B10 | DPU2_SW_3 | IBP key status (DPU2) |
| Floating analog ground | AEF | A11 | B11 | - | Not connected |
| MP3 common input (DPU2) | DPU2_COM1_3 | A12 | B12 | DPU2_EXT_CTRL0_3 | MP3 exciter setting (DPU2) |
| MP3 common input (DPU2) | DPU2_COM2_3 | A13 | B13 | DPU2_EXT_CTRL1_3 | MP3 exciter setting (DPU2) |
| ROM write in microprocessor (DPU2) | DPU2_ROM_W_SL | A14 | B14 | +6VDF2 | +6 V for floating digital circuit (DPU2) |
| MP3 connection recognition (DPU2) | - | A15 | B15 | DEF | Floating digital ground |

### CNJ604 (for MP3 board)

| Signal Description | Signal Name | Pin Number | | Signal Name | Signal Description |
|---|---|---|---|---|---|
| Floating analog ground | AEF | A1 | B1 | DEF | Floating digital ground |
| +5 V for floating analog circuit (DPU2) | +5VAF2 | A2 | B2 | +6VDF2 | +6 V for floating digital circuit (DPU2) |
| MP3 BP positive input (DPU2) | DPU2_BP+_3 | A3 | B3 | DEF | Floating digital ground |
| MP3 BP negative input (DPU2) | DPU2_BP-_3 | A4 | B4 | DEF | Floating digital ground |
| –5 V for floating analog circuit (DPU2) | –5VAF2 | A5 | B5 | DEF | Floating digital ground |
| Reference voltage (DPU2) | DPU2_VREF | A6 | B6 | DPU2_CO2_RXD_3 | MP3 CO2 serial data (RXD) (DPU2) |
| +2.5 V exciter voltage (DPU2) | DPU2_EXT25 | A7 | B7 | DPU2_CO2_TXD_3 | MP3 CO2 serial data (TXD) (DPU2) |
| –2.5 V exciter voltage (DPU2) | DPU2_EXT05 | A8 | B8 | DPU2_ROM_CLK_3 | MP3 EEPROM clock (DPU2) |
| +5 V floating for analog circuit | +5VAF2 | A9 | B9 | DPU2_ROM_DATA_3 | MP3 EEPROM data (DPU2) |
| MP3 status (DPU2) | DPU2_MP3_SL | A10 | B10 | DPU2_SW_3 | IBP key status (DPU2) |
| Floating analog ground | AEF | A11 | B11 | DEF | Floating digital ground |
| MP3 common input (DPU2) | DPU2_COM1_3 | A12 | B12 | DPU2_EXT_CTRL0_3 | MP3 exciter setting (DPU2) |
| MP3 common input (DPU2) | DPU2_COM2_3 | A13 | B13 | DPU2_EXT_CTRL1_3 | MP3 exciter setting (DPU2) |
| ROM write in microprocessor | AEF | A14 | B14 | +6VDF2 | +6 V for floating digital circuit (DPU2) |
| MP3 connection recognition (DPU1) | - | A15 | B15 | DEF | Floating digital ground |

### CNJ306 (for Mother PWR board)

| Signal Description | Signal Name | Pin Number | | Signal Name | Signal Description |
|---|---|---|---|---|---|
| Digital ground | ER | A1 | B1 | AGND | Analog ground |
| Digital ground | ER | A2 | B2 | RESP | Respiration signal |
| +8 V for respiration circuit | +8VF | A3 | B3 | PM_DETECT | Pacing pulse detection signal |
| +8 V for respiration circuit | +8VF | A4 | B4 | PWRCONT | Power control signal |
| –8 V for respiration circuit | –8VFR | A5 | B5 | F_AECGOUT | Multiplexed real time ECG/RESP waveform signal |
| –8 V for respiration circuit | –8VFR | A6 | B6 | 8kHz | A to D sync for 12 lead ECG analysis CPU |
| +V for ECG analog circuit | +VAN | A7 | B7 | AVR+ | +2.5 V for digital circuit |
| –V for ECG analog circuit | –VAN | A8 | B8 | AVR– | –2.5 V for digital circuit |
| 12 lead ECG control signal | CMD | A9 | B9 | +2.5VF2 | +V reference voltage |
| 12 lead ECG control signal | SDAT | A10 | B10 | –2.5VF2 | –V reference voltage |
| Control clock signal | F_ECLK | A11 | B11 | +8VF | +8 V for ECG circuit |
| Sync signal | F_ESYNC | A12 | B12 | +8VF | +8 V for ECG circuit |
| Real time ECG/RESP digitized data (TXD) | F_TXD | A13 | B13 | –8VF | –8 V for ECG circuit |
| Real time ECG/RESP digitized data (RXD) | R_RXD | A14 | B14 | –8VF | –8 V for ECG circuit |
| Digital around | ER | A15 | B15 | AGND | Analog ground |
| Digital around | ER | A16 | B16 | –2.5VF3 | –2.5 V for digital circuit |
| Digital around | ER | A17 | B17 | AVR+ | +V reference voltage |
| +2.5V for digital circuit | +2.5VF3 | A18 | B18 | AVR– | –V reference voltage |
| Analog ground | AGND | A19 | B19 | AGND | Analog ground |
| Analog ground | AGND | A20 | B20 | AGND | Analog ground |

### CNJ402 (for Mother PWR board)

| Signal Description | Signal Name | Pin Number | | Signal Name | Signal Description |
|---|---|---|---|---|---|
| +10 V LED drive voltage | +10UF | A1 | B1 | F_SCLK | Control clock signal |
| +10 V LED drive voltage | +10UF | A2 | B2 | –5F | –5 V for SpO2 circuit |
| LED drive circuit ground | LEF | A3 | B3 | –5F | –5 V for SpO2 circuit |
| +2.5 V reference voltage | +2.5F | A4 | B4 | F_SSYNC | Sync signal |
| +5 V for digital circuit | +5DF | A5 | B5 | F_SPO2_RXD | Power for SpO2 circuit |
| +5 V for digital circuit | +5DF | A6 | B6 | AMPEF | Analog ground |
| Power for SpO2 circuit | F_SPO2 | A7 | B7 | F_SAMPCK | Control clock signal |
| –2.5 V reference voltage | –2.5F | A8 | B8 | EF | Analog ground |
| +5 V for SpO2 circuit | +5F | A9 | B9 | F_SPO2_TXD | Probe short circuit detection signal |
| +5 V for SpO2 circuit | +5F | A10 | B10 | EF | Analog ground |
| LED drive circuit ground | LEF | A11 | B11 | EF | Analog ground |
| Analog ground | EF | A12 | B12 | EF | Analog ground |
| Analog ground | EF | A13 | B13 | EF | Analog ground |
| Analog ground | EF | A14 | B14 | EF | Analog ground |
| Analog ground | EF | A15 | B15 | EF | Analog ground |

### CNJ605 (for Mother PWR board)

| Signal Description | Signal Name | Pin Number | | Signal Name | Signal Description |
|---|---|---|---|---|---|
| MP1,2, TEMP connector side digital power supply | +6VDF1 | A1 | B1 | AEF | Analog ground |
| MP1,2, TEMP connector side digital power supply | +6VDF1 | A2 | B2 | +5VDF2 | MP3,4,5 connector side pull-up voltage |
| PWM signal for IBP analog output | F_IBP_PWM | A3 | B3 | AEF | Analog ground |
| Digital ground | DEF | A4 | B4 | −5VAF2 | MP3,4,5 connector side analog voltage |
| MP1,2, TEMP connector side control signal | MP_DPU1_RXD | A5 | B5 | −5VAF2 | MP3,4,5 connector side analog voltage |
| MP1,2,TEMP connector side data | MP_DPU1_TXD | A6 | B6 | AEF | Analog ground |
| Digital ground | DEF | A7 | B7 | +5VDF2 | MP3,4,5 connector side analog voltage |
| MP1,2, TEMP connector side analog voltage | +5VAF1 | A8 | B8 | +5VDF2 | MP3,4,5 connector side analog voltage |
| MP1,2, TEMP connector side analog voltage | +5VAF1 | A9 | B9 | DEF | Digital ground |
| Analog ground | AEF | A10 | B10 | MP_DPU2_RXD | MP3,4,5 connector side control signal |
| MP1,2, TEMP connector side analog voltage | −5VAF1 | A11 | B11 | MP_DPU2_TXD | MP3,4,5 connector side data |
| MP1,2, TEMP connector side analog voltage | −5VAF1 | A12 | B12 | DEF | Digital ground |
| MP1,2, TEMP connector side pull up voltage | +5VDF1 | A13 | B13 | MP_DPU2_nRST | MP3,4,5 side CPU reset |
| MP1,2, TEMP connector side CPU reset | MP_DPU1_nRST | A14 | B14 | +6VDFF2 | MP3,4,5 connector side digital power supply |
| Analog ground | AEF | A15 | B15 | +6VDFF2 | MP3,4,5 connector side digital power supply |
| MP1,3, TEMP connector side digital power supply | +6VDF1 | A16 | B16 | +6VDFF2 | MP3,4,5 connector side digital power supply |
| Analog ground | AEF | A17 | B17 | AEF | Analog ground |
| Digital ground | DEF | A18 | B18 | DEF | Analog ground |
| Digital ground | DEF | A19 | B19 | DEF | Digital ground |
| Digital ground | DEF | A20 | B20 | DEF | Digital ground |

# Mother PWR Board

### CNJ701 (for DPU SP board)

Refer to "CNJ022 (for Mother PWR board)" in the "DPU SP Board" section.

### CNJ306 (for Mother CN board)

Refer to "CNJ306 (for Mother PWR board)" in the "Mother CN Board" section.

### CNJ402 (for Mother CN board)

Refer to "CNJ402 (for Mother PWR board)" in the "Mother CN Board" section.

### CNJ605 (for Mother CN board)

Refer to "CNJ605 for Mother PWR board" in the "Mother CN Board" section.

### CNJ501 (for Nellcor SpO2 module)

| Signal Description | Signal Name | Pin Number | | Signal Name | Signal Description |
|---|---|---|---|---|---|
| Not connected | N.C. | 1 | 2 | EF | Floating ground |
| Floating ground | EF | 3 | 4 | RESET | Reset output |
| Floating ground | EF | 5 | 6 | N.C. | Not connected |
| –5 V for analog circuit | –5F | 7 | 8 | NEL_TX | MP304 serial data (RXD) |
| MP304serial data (TXD) | NEL_RX | 9 | 10 | +5F | +5 V for analog circuit |
| Not connected | N.C. | 11 | 12 | EF | Floating ground |
| +5 V for digital circuit | +5DF | 13 | 14 | XNEL | MP304 connection recognition |

# Operation Board

### CN101 (for Function Dial board)

| Pin Number | Signal Name | Signal Description |
|---|---|---|
| 1 | JOGL_A | Lower function dial A signal |
| 2 | JOGL_B | Lower function dial B signal |
| 3 | JOGU_A | Upper function dial A signal |
| 4 | JOGU_B | Upper function dial B signal |
| 5 | +5V | +5 V supply voltage |
| 6 | E2 | Digital ground |
| 7 | XLED_JOGU | Upper function dial LED |
| 8 | XLED_JOGL | Lower function dial LED |
| 9 | E2 | Digital ground |
| 10 | E2 | Digital ground |

### CN102 (for MAIN board)

| Pin Number | Signal Name | Signal Description |
|---|---|---|
| 1 | JOGL_A | Lower function dial A signal |
| 2 | JOGL_B | Lower function dial B signal |
| 3 | JOGU_A | Upper function dial A signal |
| 4 | JOGU_B | Upper function dial B signal |
| 5 | +5V | +5 V supply voltage |
| 6 | E2 | Digital ground |
| 7 | XLED_JOGU | Upper function dial LED |
| 8 | XLED_JOGL | Lower function dial LED |
| 9 | XKEY1 | SILENCE ALARMS key |
| 10 | XKEY2 | NIBP INTERVAL key |
| 11 | XKEY3 | NIBP START/STOP key |
| 12 | XKEY4 | MENU key |
| 13 | XKEY5 | HOME key |
| 14 | E2 | Digital ground |
| 15 | E2 | Digital ground |
| 16 | E2 | Digital ground |
| 17 | E2 | Digital ground |
| 18 | E2 | Digital ground |
| 19 | E2 | Digital ground |
| 20 | E2 | Digital ground |

# Alarm SP Board

**CN1 (for MAIN board)**

| Pin Number | Signal Name | Signal Description |
|---|---|---|
| 1 | +15V | +15 V supply voltage |
| 2 | XRED | Red LED cluster control |
| 3 | XYELLOW | Yellow LED cluster control |
| 4 | XGREEN | Green LED cluster control |

# Power SW Board

**CN101 (for MAIN board)**

| Pin Number | Signal Name | Signal Description |
|---|---|---|
| 1 | +15V | +15 V supply voltage |
| 2 | XKEY_POWER | Power switch |
| 3 | XLED_POWER | Power LED |
| 4 | XLED_STBY | AC power LED |
| 5 | XLED_BATOP | Battery power LED |
| 6 | XLED_BTCHG | Battery charging LED |
| 7 | E2 | Digital ground |
| 8 | E2 | Digital ground |
| 9 | XKEY_REC | Record key |
| 10 | XLED_PAPER | Out of paper LED |
| 11 | +5V | +5 V supply voltage |
| 12 | E2 | Digital ground |

# Connection Board

**CN101 (for LCD unit)**

| Pin Number | Signal Name | Signal Description |
|---|---|---|
| 1 | +3.3V | +3.3 V supply voltage |
| 2 | +3.3V | +3.3 V supply voltage |
| 3 | E2 | Digital ground |
| 4 | E2 | Digital ground |
| 5 | IN0– | LCD Y0 – signal |
| 6 | IN0+ | LCD Y0 + signal |
| 7 | IN1– | LCD Y1 – signal |
| 8 | IN1+ | LCD Y1 + signal |
| 9 | IN2– | LCD Y2 – signal |
| 10 | IN2+ | LCD Y2 + signal |
| 11 | CLKIN– | LCD CK – signal |
| 12 | CLKIN+ | LCD CK + signal |
| 13 | NC | Not connected |
| 14 | NC | Not connected |
| 15 | NC | Not connected |
| 16 | NC | Not connected |
| 17 | NC | Not connected |
| 18 | NC | Not connected |
| 19 | NC | Not connected |
| 20 | NC | Not connected |

### CN102 (for touch screen)

| Pin Number | Signal Name | Signal Description |
|---|---|---|
| 1 | NC | Not connected |
| 2 | TOUCH_U | Touch screen U signal |
| 3 | NC | Not connected |
| 4 | TOUCH_R | Touch screen R signal |
| 5 | NC | Not connected |
| 6 | TOUCH_A | Touch screen A signal |
| 7 | NC | Not connected |
| 8 | TOUCH_L | Touch screen L signal |
| 9 | NC | Not connected |
| 10 | TOUCH_B | Touch screen B signal |
| 11 | NC | Not connected |
| 12 | TOUCH_D | Touch screen D signal |
| 13 | NC | Not connected |
| 14 | TOUCH_C | Touch screen C signal |
| 15 | NC | Not connected |

### CN103 (for MAIN board)

Refer to “CN102 (for Connectinon board)” in the “MAIN board” section.

# Inverter Board

### CN1 (for MAIN board)

| Pin Number | Signal Name | Signal Description |
|---|---|---|
| 1 | +15V | +15 V supply voltage for inverter |
| 2 | +15V | +15 V supply voltage for inverter |
| 3 | E2 | Digital ground |
| 4 | E2 | Digital ground |
| 5 | CNT | Backlight ON/OFF control |
| 6 | VR | Brightness control |
| 7 | NC | Not connected |
| 8 | NC | Not connected |

### CN2 (for backlight)

| Pin Number | Signal Name | Signal Description |
|---|---|---|
| 1 | Vout-Lo | Low voltage output for backlight (cold cathode tube) |
| 2 | NC | Not connected |
| 3 | NC | Not connected |
| 4 | NC | Not connected |
| 5 | Vout-Hi | High voltage output for backlight (cold cathode tube) |
| 6 | NC | Not connected |
| 7 | Vout-Hi | High voltage output for backlight (cold cathode tube) |

# Function Dial Board

### CN101 (for Operation board)

Refer to "CN101 (for Function Dial board)" in the "Operation Board" section.

# AG IF Board

### CN001 (for Dryline receptacle)

| Pin Number | Signal Name | Signal Description |
|---|---|---|
| 001 | +5VD | +5V supply voltage for digital circuit |
| 002 | Wt Type | Dryline type status signal |
| 003 | Wt Mounted | Dryline connection status signal |
| 004 | DGND | Digital ground |

### CN002 (for AION unit)

| Pin Number | Signal Name | Signal Description |
|---|---|---|
| 001 | DGND | Digital ground |
| 002 | Wt Mounted | Dryline connection status signal |
| 003 | Wt Type | Dryline type status signal |
| 004 | +5VD | +5V supply voltage for digital circuit |
| 005 | NC | Not connected |
| 006 | NC | Not connected |
| 007 | NC | Not connected |
| 008 | NC | Not connected |
| 009 | NC | Not connected |
| 010 | A Ground | Analog ground |
| 011 | +5VA | +5V supply voltage for analog circuit |
| 012 | NC | Not connected |
| 013 | NC | Not connected |
| 014 | A Ground | Analog ground |
| 015 | 02p | Oxygen sensor analog signal |
| 016 | NC | Not connected |
| 017 | NC | Not connected |
| 018 | NC | Not connected |
| 019 | Power Ground | Ground for power supply unit |
| 020 | Power Ground | Ground for power supply unit |
| 021 | Power Supply | +15V supply voltage |
| 022 | Power Supply | +15V supply voltage |
| 023 | DGND | Digital ground |
| 024 | RXD Srvice | AION Receive Data for upgrade (service) |
| 025 | TXD Srvice | AION Transmit Data for upgrade (service) |
| 026 | DGND | Digital ground |
| 027 | AION_RXD | AION control signal |
| 028 | AION_TXD | AION gas data |
| 029 | NC | Not connected |
| 030 | NC | Not connected |
| 031 | NC | Not connected |
| 032 | DGND | Digital ground |
| 033 | Reset | AION reset signal |
| 034 | Flash Prog | AION flash ROM program upgrade mode select signal |

### CN003 (for Oxygen sensor)

| Pin Number | Signal Name | Signal Description |
|---|---|---|
| 001 | NC | Not connected |
| 002 | NC | Not connected |
| 003 | NC | Not connected |
| 004 | NC | Not connected |
| 005 | NC | Not connected |
| 006 | NC | Not connected |
| 007 | 02p | Oxygen sensor analog signal |
| 008 | A Ground | Analog ground |
| 009 | NC | Not connected |
| 010 | NC | Not connected |
| 011 | +5VA | +5V supply voltage for analog circuit |
| 012 | A Ground | Analog ground |
| 013 | NC | Not connected |
| 014 | NC | Not connected |
| 015 | NC | Not connected |
| 016 | NC | Not connected |

### CN004 (for a PC to upgrade the AION unit)

| Pin Number | Signal Description | Function |
|---|---|---|
| 001 | RXD Srvice | AION Receive Data for upgrade (service) |
| 002 | TXD Srvice | AION Transmit Data for upgrade (service) |
| 003 | DGND | Digital ground |
| 004 | | AG IF board control signal |
| 005 | DGND | Digital ground |

### CN005 (for DPU SP board)

| Pin Number | Signal Description | Function |
|---|---|---|
| 001 | +15VIN | +15V Supply voltage |
| 002 | +15VIN | +15V Supply voltage |
| 003 | +15VIN | +15V Supply voltage |
| 004 | DGND | Digital ground |
| 005 | DGND | Digital ground |
| 006 | DGND | Digital ground |
| 007 | AGVERUP | AG IF mode select signal |
| 008 | P_TXD | Gas data (serial communication from AG IF board to DPU SP board) |
| 009 | P_RXD | Control signal (serial communication from DPU SP board to AG IF board) |
| 010 | _RESET | Reset signal |
| 011 | NC | Not connected |
| 012 | NC | Not connected |
| 013 | NC | Not connected |
| 014 | NC | Not connected |

### CN006 (for Origion side stream $CO_2$ Sensor)

| Pin Number | Signal Description | Function |
|---|---|---|
| 001 | NC | Not connected |
| 002 | NC | Not connected |
| 003 | DGND | Digital ground |
| 004 | DGND | Digital ground |
| 005 | DGND | Digital ground |
| 006 | +5VCO2 | +5V supply voltage |
| 007 | EXT_RESET | Origion reset signal |
| 008 | TXD | Origion Co2 data |
| 009 | RXD | Origion control signal |
| 010 | NC | Not connected |

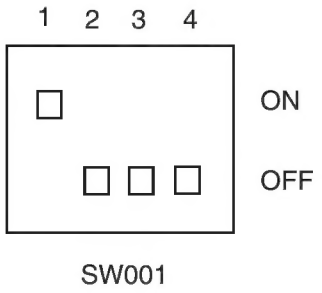
# *Section 10 Internal Switch Setting and Board Compatibility*


Internal Switch Setting ..... 10.1
MAIN Board ..... 10.1
DPU SP Board ..... 10.1
Board Compatibility ..... 10.2
MAIN Board ..... 10.2
SpO2 Board ..... 10.2
ECG RESP1, ECG RESP2, ECG RESP3 and Mother PWR Boards ..... 10.2

# Internal Switch Setting

### MAIN Board

When you replace the MAIN board with a new one, set the bit switches of the DIP switch SW001 on the new MAIN board.

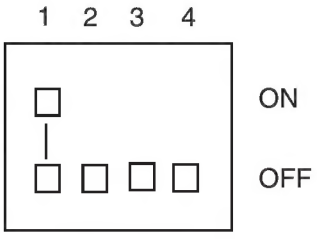



SW001

Bit 1:
ON: for BSM-5100 series
OFF: for BSM-4100 series
Bit 2:
ON: for domestic model
OFF: for BSM-5100 series
Bit 3:
ON: for BSM-4100 series without recorder
OFF: for BSM-4100 series with recorder or BSM-5100 series
Bit 4: Reserved. But check that it is set to OFF.

### DPU SP Board

When you replace the DPU SP board with a new one, set the bit switches of the DIP switch SW2201 on the new DPU SP board.




SW2201

Bit 1:
ON: for BSM-513x
OFF: for BSM-510x
Bits 2 to 4: Reserved. But check that they are set to OFF.

# Board Compatibility

### MAIN Board

Since the MAIN board has had a design change to be commonly used between the BSM-4100 series and BSM-5100 series, specify the appropriate hardware revision (indicated on the label on the board) when you issue an order for a replacement MAIN board.

If there is a MAIN board in your stock, check the hardware revision to determine if it is for BSM-4100 series only or for both BSM-5100 and BSM-4100 series.

| Model | Hardware Revision BF or earlier | Hardware Revision BG or later |
|---|---|---|
| **BSM-5100 series** | Error | OK |
| **BSM-4100 series** | OK | OK |

### $SpO_2$ Board

Note that the $SpO_2$ function does not work if the software version 01-07 or earlier and hardware revision BC or later are used together.

| | Hardware Revision BB or earlier | Hardware Revision BC or later |
|---|---|---|
| **Software Version 01-07 or earlier** | OK | Error |
| **Software Version 01-10 or later** | OK | OK |

### ECG RESP1, ECG RESP2, ECG RESP3 and Mother PWR Boards

When one of these boards has a failure, all of these boards must be replaced at the same time with the YS-086P3 ECG input block repair kit. This kit contains ECG RESP1, ECG RESP2, ECG RESP3 and mother PWR boards that are adjusted at the factory to work together.

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**The model and serial number of your instrument are identified on the rear or bottom of the unit. Write the model and serial number in the spaces provided below. Whenever you call your distributor concerning this instrument, mention these two pieces of information for quick and accurate service.**

**Model** _____ **Serial number** _____

**Your Distributor**

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